PHILIPPINE AGRICULTURAL REVIEW

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Hon. B. Walter

VOL. I JANUARY, 1908 No. 1

The Philippine Agricultural Review

A MONTHLY PUBLICATION ISSUED IN ENGLISH AND SPANISH AND CIRCULATED FREE OF CHARGE IN THE PHILIPPINE ISLANDS

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PUBLISHED BY THE

BUREAU OF AGRICULTURE

DEPARTMENT OF THE INTERIOR

GOVERNMENT OF THE PHILIPPINE ISLANDS

Applicants for The Philippine Agricultural Review should state whether the English or the Spanish edition is desired. Address all communications relative to this publication to the Director of the Bureau of Agriculture, Manila, P. I.

MANILA
BUREAU OF PRINTING
1908

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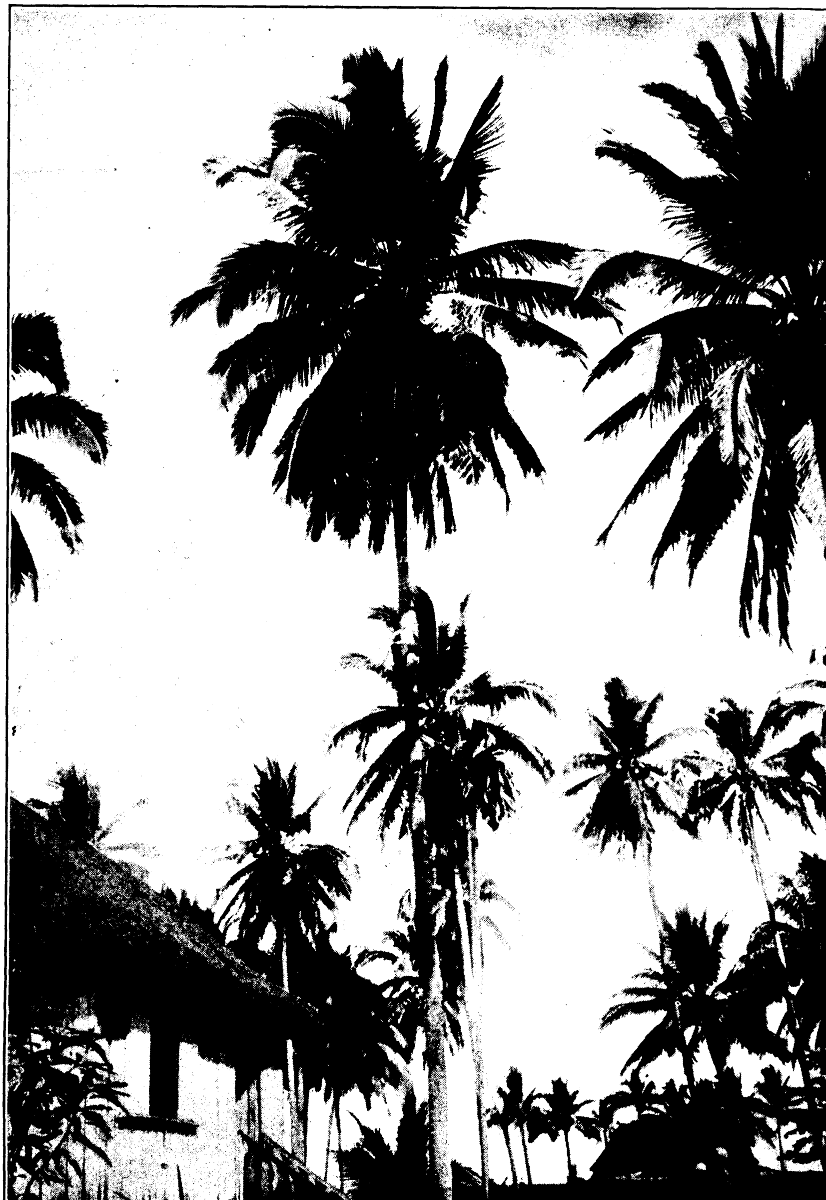

PLATE I.

The Philippine

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THE ORIGIN OF THE PHILIPPINE AGRICULTURAL REVIEW.

EXTRACT FROM ANNUAL REPORT.

[Extract from Report of the Acting Director of Agriculture for the fiscal year ending June 30, 1907.]

Our press bulletin has grown to such proportions that with the addition of the statistical division and crop-reporting service this bulletin might well be further enlarged into a monthly publication, to be issued and circulated as a periodical.

LETTER OF RECOMMENDATION.

MANILA, *July 3, 1907.*

SIR: I have the honor to recommend that the Bureau of Agriculture issue a monthly bulletin in place of the press bulletins, which are now published at irregular intervals.

It is essential that the farmers throughout the provinces be brought more closely in touch with the work of the Bureau of Agriculture. This fact is of particular importance in connection with our seed and plant distribution and the control of infective animal diseases. A considerable part of the work now accomplished by means of circulars, circular letters, and correspondence could be more satisfactorily and thoroughly done through the medium of a monthly publication.

We now receive monthly crop-service reports from more than half the municipalities in the Islands. A brief summary of these reports would be of general interest, if published regularly every month.

The further development of the maguey industry, the planting of kapok trees, and other similar lines of work should be systematically and constantly kept before the people. Interest in these questions is easily aroused, but soon dies out unless constantly renewed. This kind of work can not be done thoroughly either by correspondence or by our present system of bulletins.

For the above-mentioned and other reasons, it is believed that the publication of a monthly bulletin by this Bureau would be desirable.

Very respectfully,

G. E. NESOM, *Acting Director.*

The SECRETARY OF THE INTERIOR.

[First indorsement.]

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,
DEPARTMENT OF THE INTERIOR,
Manila, August 22, 1907.

Respectfully returned to the Acting Director of Agriculture.

The proposition of a monthly bulletin is approved. Probably it ought to be published in Spanish as well as in English in order that it may reach a larger circle of people. * * *

DEAN C. WORCESTER,
Secretary of the Interior.

LETTER OF TRANSMITTAL.

BUREAU OF AGRICULTURE,
Manila, December 26, 1907.

SIR: I have the honor to transmit herewith, and to recommend for publication, the manuscript of Volume I, No. 1, of the proposed PHILIPPINE AGRICULTURAL REVIEW.

I respectfully recommend that this publication be issued monthly hereafter in English and Spanish and sent free of charge to all citizens of the Philippine Islands who may make application for either edition.

Very respectfully,

G. E. NESOM, *Director.*

The SECRETARY OF THE INTERIOR.

THE PHILIPPINE

Agricultural Review

Vol. I JANUARY, 1908 No. 1

EDITORIAL.

This is the first number of THE PHILIPPINE AGRICULTURAL REVIEW, a monthly bulletin to be published regularly hereafter by the Bureau of Agriculture. It is designed to take the place of the press bulletins heretofore issued by this Bureau. It is not intended to be a journal of a technical nature, but rather a popular serial publication on general agriculture, designed as an educational means of reaching the people of the Philippine Islands with the work of the Bureau of Agriculture.

In addition to this monthly bulletin we will continue to publish our technical bulletins and the popular series intended for primary instruction.

The REVIEW, in either English or Spanish, will be sent free of charge to all citizens of the Philippine Islands who may apply for it. It will also be sent to government departments of agriculture, experiment stations, and botanic gardens in exchange for the publications issued by such institutions.

A limited number of copies will be sent free to foreign workers along agricultural lines in recognition of valuable services rendered this Bureau.

Should there appear to be a demand for regular foreign subscriptions, arrangements will be perfected later for furnishing them at a reasonable price.

This first number is devoted entirely to the annual report for the past fiscal year, and is so published in order to give a comprehensive idea to those who may not know of the organization, scope, and extent of the work of this Bureau.

In succeeding numbers a series of articles on various subjects of general agriculture will appear and will be so distributed as to make the REVIEW of interest to all readers of agricultural literature.

REPORT OF THE BUREAU OF AGRICULTURE FOR THE FISCAL YEAR ENDING JUNE 30, 1907.

CONTENTS.

ILLUSTRATIONS.

MANILA, *August 14, 1907.*

SIR: I have the honor to submit herewith my report as Acting Director of Agriculture for the fiscal year ending June 30, 1907.

ORGANIZATION.

The organization of the Bureau of Agriculture includes the following three divisions: Administrative, plant industry, and animal industry.

ADMINISTRATIVE DIVISION.

The work of the administrative division includes the general administration of the central office of the Bureau in Manila and of outlying experiment stations and stock farms; also such special lines of work as publications, crop reporting and statistics, steam plowing, etc., which do not properly come under the divisions of plant and animal industry.

PERSONNEL.

The Director of Agriculture was granted leave of absence with permission to return to the United States, and sailed from Manila on March 19, 1907.[1] Since that time the Assistant Director has been performing the duties of the Director, including the submission of this report. On account of this fact the matter herein contained will probably not be as full and explicit on certain questions which were handled entirely by the Director as it otherwise would have been.

Some difficulty has been experienced in keeping the working force of the Bureau up to the desired standard. The meat-inspection law went into effect in the United States last year, the entrance salary of veterinarians was raised from $1,200 to $1,400, and there was a great demand for veterinarians of all grades on account of the increased number of positions existing. This affected the Bureau of Agriculture to the extent of taking away the entire veterinary force in its employ one year ago except three men. Every effort has been made to refill the vacancies, but so far only five veterinarians have been induced to come out from the United States. Cable advice has been received from Washington that only three additional veterinarians are available for appointment. The salaries offered by this Government would appear to be adequate, but the very bright business outlook in the United States, the ease with which veterinarians secure employment in the Bureau of Animal Industry, and the handsome returns secured by private practice all conspire to prevent men of this profession from coming to the Philippines.

The six agricultural inspectors provided for in the appropriation for the current year were appointed, and arrived here during the months of November and December, 1906. These inspectors were given a preliminary period of instruction in the work which they were expected to perform in the provinces, especially in the suppression of infective animal diseases, and were assigned to their several stations about the 1st of January.

It seems very desirable to increase the number of veterinarians, inspectors, and assistant inspectors so that there shall be at least one veterinarian, inspector, or assistant inspector for each province and important island in the Archipelago. It is imperative that those who are sent to

[1] The resignation of Prof. W. C. Welborn, Director of Agriculture, was cabled from Washington July 18, and accepted effective June 3, 1907.

suppress outbreaks of infective animal diseases arrive on the spot promptly before the disease has had time to spread, and the nearer the man is to the location of the outbreak the easier it becomes to reach there promptly.

A requisition was placed with the Bureau of Civil Service on March 23, 1907, for a stenographer at ₱2,400 per annum. This addition to the clerical force has seemed imperative and yet we have been advised month after month that no additional stenographers were available. This probably indicates that the salary offered is too low and that we shall have to increase the pay or fill the position with a lower-grade employee.

It is necessarily a difficult matter to secure from the United States persons who are qualified to enter at once into active service in tropical agriculture. In this connection the assistance and coöperation of the Bureau of Civil Service have been of great value.

The native clerical force is increasing in efficiency year by year, and it now seems probable that this branch of the force can be increased and the number of higher-priced American employees gradually decreased, thereby economizing in the cost of clerical work. It is recommended that a number of native clerks heretofore working as temporary employees be appointed permanently in the classified service.

The Bureau force at present consists of the Director, Assistant Director, chief clerk, fiber expert, horticulturist, statistician, property clerk, 2 stenographers, 5 clerks, 7 veterinarians, 6 agricultural inspectors, 4 assistant agricultural inspectors, machinery expert, 4 farm superintendents, 4 farm foremen, carpenter, dairyman, stable foreman, matadero inspector, 10 temporary employees, and 3 messengers, in addition to laborers at stations and farms.

The year shows a gain of 15 and a loss of 20, or a net loss of 5 classified employees.

PUBLICATIONS.

During the year the following publications have been issued:

Title.	Author.	Issued.	Language.
FARMERS' BULLETINS.			
No. 13:			
El Cultivo del Maguey en las Islas Filipinas (reimpreso).	H. T. Edwards	Aug. 27, 1906	Spanish.
No. 14:			
El Cultivo del Sésamo en las Islas Filipinas.	Wm. S. Lyon	Aug. 29, 1906	Do.
PRESS BULLETINS.			
No. 8:			
Maguey, Propagating Abacá from Seed, etc.	H. T. Edwards	Nov. 9, 1906	English.
No. 9:			
Bureau of Agriculture Districts of the Philippines, Control of Rinderpest, etc.	G. E. Nesom	Feb. 5, 1907	Do.

Title.	Author.	Issued.	Language.
PRESS BULLETINS—Continued.			
No. 10: The Weevil Pest and Its Remedy, Maguey, etc.	H. T. Edwards	Apr. 24, 1907	English.
No. 10: La Plaga de Gorgojos y su Remedio, Maguey, etc.	do	do	Spanish.
CIRCULARS.			
Instructions for Planting Field and Garden Seeds.	Wm. S. Lyon	July 19, 1906	Spanish.
Maguey	H. T. Edwards	July 27, 1906	English.
Do	do	do	Spanish.
Do	do	do	Ilocano.
Do	do	do	Tagalog.
Do	do	Sept. 12, 1906	Boholano.
Maguey (reprint)	do	do	Tagalog.
Do	do	do	Spanish.
Maguey	do	Nov. 8, 1906	Masbate.
Do	do	Apr. 24, 1907	Cebuano.
Maguey (reprint)	do	May 16, 1907	English and Spanish.
No. 1: Crop-Reporting Service.	do	Nov. 11, 1906	Spanish.
No. 1: Crop-Reporting Service.	do	do	English.
Instructions for Planting Field and Garden Seeds (reprint).	Wm. S. Lyon	Mar. 19, 1906	Spanish.

There is a constantly increasing demand for publications on agricultural subjects, and extensive distributions of our bulletins have been made within the year.

Our press bulletin has grown to such proportions that with the addition of the statistical division and crop-reporting service this bulletin might well be further enlarged into a monthly publication, to be issued and circulated as a periodical.

The circular on maguey was published in the languages of those provinces and islands where the greatest interest existed in this subject. This circular has accomplished excellent results and it is safe to say that of all the crops generally advocated for the Philippines none has created up to this time the same interest that has been manifested in maguey. This fact has suggested the desirability of issuing similar circulars on such other subjects as kapok, corn, rice, pineapples, cacao, and sesamum, and all of the infective animal diseases prevalent in the Islands.

The mailing list of the Bureau has been revised so as to avoid sending bulletins and other publications to persons who would not receive and make good use of them.

CROP REPORTS AND STATISTICS.

ORGANIZATION.

In the annual appropriation for the current fiscal year provision was made for a statistician whose duty it should be to organize and give constant supervision to a crop-reporting service throughout the Islands, and so record and classify the statistics thus obtained that they should be available for reference and publication.

On October 1, 1906, Mr. B. L. Moss was appointed to this position and began at once the organization of the work. On October 29 he presented a report and recommendation to the Director of Agriculture in which a proposed plan of organization was given. The proposed work of this division, briefly stated, was to obtain regular and reliable information relative to crops and live stock in all parts of the Islands, to summarize and tabulate this information so that it may be in the highest degree useful and available, and to publish such part of the information received as may seem desirable.

In order to obtain the information required it was proposed to organize a crop-reporting service with a corps of municipal, provincial, and district reporters, the latter to be our agricultural inspectors, who were also to have a general supervision of the work of all other reporters. Each one of these reporters was to furnish a regular monthly and annual report on the agricultural conditions within his municipality, province, or district, these reports to be made out on forms furnished by this Bureau. This service, except in the case of our regularly appointed inspectors, was to be gratuitous. The crops to be reported upon were abacá, maguey, sugar, rice, copra, and tobacco. The information to be furnished regarding these crops included the area planted and harvested, condition and value of crops, etc. The live stock to be reported upon included horses, cattle, carabaos, goats, sheep, and hogs. The information to be furnished regarding live stock included the number and condition of animals, increase and decrease, number of cases of disease, and nature of disease.

BUREAU OF AGRICULTURE DISTRICTS.

It had been planned to divide the entire Archipelago into districts, in each of which should be stationed at least one veterinarian and one agricultural inspector or assistant inspector. It was arranged that, when opportunity permitted, the representatives of this Bureau, especially the agricultural inspectors, should employ their time in personally organizing and supervising the crop-reporting service.

The Bureau of Agriculture has established nine agricultural districts

in the Philippines, including all provinces and important islands. These districts are as follows:

District No. 1: Cagayan, Isabela, and Nueva Vizcaya; headquarters, Tuguegarao; substation, Ilagan.

District No. 2: Ilocos Norte, Ilocos Sur, and La Union; headquarters, Vigan; substations, Laoag and San Fernando (La Union).

District No. 3: Pangasinan, Benguet, Lepanto-Bontoc, and Tarlac; headquarters, Dagupan; substations Baguio, Cervantes, and Tarlac.

District No. 4: Zambales, Bataan, Pampanga, Nueva Ecija La Laguna, Rizal, Manila, Cavite, Batangas, Tayabas (part on west coast), Mindoro, Palawan, Marinduque, Romblon, and Bulacan; headquarters, Manila; substations, Iba, Lamao, San Fernando (Pampanga), San Isidro, Batangas, Lipa, Lucena, Santa Cruz (La Laguna), and Alabang.

District No. 5: Ambos Camarines, Albay, Sorsogon, Masbate, and Tayabas (part on east coast); headquarters, Legaspi; substations, Nueva Caceres, Sorsogon, and Masbate.

District No. 6: Samar and eastern Leyte; headquarters, Tacloban; substation, Catbalogan.

District No. 7: Cebu, Negros Oriental, Bohol, Misamis, Surigao, and western Leyte; headquarters, Cebu; substations, Tagbilaran, Dumaguete, Cagayan, and Surigao.

District No. 8: Iloilo, Capiz, Antique, and Negros Occidental; headquarters, Iloilo; substations, Silay, La Carlota, and Capiz.

District No. 9: Moro Province; headquarters, Zamboanga; substation, Davao.

SUBSEQUENT OPERATIONS.

The annual-report form for the calendar year 1906 was prepared and sent out to all correspondents who, up to January 1, had been engaged to undertake the work. The preparation of reports was not fully understood by the correspondents, and after a wait of thirty days only a few dozen reports had been filled out and returned. On February 1 Mr. Moss was granted leave of absence with permission to visit the United States, and from that date to the close of the fiscal year Mr. H. T. Edwards was in charge of this work. Much of the remainder of the fiscal year was spent in corresponding with provincial and municipal authorities with a view to securing their hearty coöperation in this work, and the agricultural inspectors and other employees of this Bureau in the provinces visited many different municipalities for the purpose of arranging personally with correspondents who would furnish us with the desired information.

A number of circular letters were sent out, and the correspondence involved has been necessarily very extensive. A system of filing and indexing the reports received was effected and blank forms were prepared for tabulating all of the statistics obtained.

All of this work has taken much time and patience, but the results obtained have been fairly satisfactory.

PROGRESS OF THE WORK.

The establishment of an efficient crop-reporting service in a country like the Philippine Islands, where agriculture is comparatively undeveloped and transportation facilities are limited, is necessarily slow work. In view of the conditions above mentioned, it is considered that the progress made is most encouraging. On January 1 the service was in progress of organization. At that time we had no reporters and had received no reports. On June 30 we had a corps of 370 municipal reporters, representing 308 municipalities, or nearly one-half the total number of municipalities in the Islands, and had received a total number of 1,628 reports. It is believed that the practicability of establishing a crop-reporting service in this country has been fully demonstrated, and that this service can be extended during the present year so as to include every municipality in the Archipelago.

We now send every month to each reporter a printed form for the report, a stamped return envelope, and a circular or circular letter on some agricultural subject of current interest.

QUALITY OF REPORTS.

The primary requisites of an efficient crop reporter are that he shall prepare accurate and complete reports and shall forward these reports regularly and promptly. The preparation of satisfactory crop reports requires a certain amount of experience and training, and all of our reporters are as yet new to the work. We receive many excellent reports, and others that might well be improved. The quality of the reports as a whole is very good, and it is only reasonable to suppose that it will improve as our reporters become accustomed to the work and gain more experience. The reports are not received as promptly as might be desired, but improvement in this direction is noticeable from month to month.

COMPILATION OF REPORTS.

Up to the present time no attempt has been made to compile or tabulate the statistics received. The necessary forms for this tabulation have been prepared and are now in the hands of the printer. As soon as these forms are received this work can be taken up.

PUBLICATION OF REPORTS.

An essential part of a crop-reporting service is the prompt publication of the data received. This work can not be satisfactorily done until the service is fairly well established. Up to the present time the only crop-service data published have been a few brief reports on agricultural conditions in the provinces. This service now furnishes sufficient material for a monthly "Crop Reporter," and such a publication would greatly increase the efficiency of the work.

PRACTICAL RESULTS OF THE CROP-REPORTING SERVICE.

The collection of statistics and information regarding agricultural conditions throughout the Islands is a most important line of work, but of even greater importance is the fact that the crop-reporting service brings the Bureau into direct touch with the farmers of every municipality where we have a reporter, not occasionally and infrequently, but regularly every month. The reporter is, in a certain sense, the representative of the Bureau of Agriculture in the municipality. He knows what the Bureau is in a position to do for the farmers, and he knows the needs of the farmers in his particular municipality. The greatest obstacle in the way of improvement of agricultural conditions in the provinces is to get in touch with the average Filipino farmer. The crop service offers a simple and practicable means of bringing this about.

In connection with the monthly reports we receive many requests for seeds, plants, and publications, and requests for assistance in the work of stamping out infective animal diseases and destroying pests. As our reporters become better acquainted with the work of the Bureau and when, through the monthly reports, we know more about the actual conditions in each municipality, this work can be largely extended.

PUBLIC SERVICES.

SEED AND PLANT DISTRIBUTION.

EXTENT.

Interest in the seed distribution remains unabated. The number of applicants for seed is increasing, and the amount of seed sent out has exceeded that of any previous year. A gratifying feature of this work has been the largely increased number of applications for farm seeds. During the fiscal year ending June 30, 1907, 42 per cent of all the collections issued were farm seed, as compared with 20.5 per cent for the previous year.

The total distributions of farm and garden seeds during the year have been as follows: Farm seeds, 2,184 collections, each of which contained one or more kinds of seed; garden seeds, 3,763 collections, averaging 8 packets of seed to each collection. These were sent to 3,078 different persons in 519 different municipalities and barrios. This distribution included every province in the Archipelago. In addition to seeds sent out, 1,361 packets of garden seeds were given to people who called at the office of the Bureau in Manila.

CLASSES OF SEEDS AND PLANTS DISTRIBUTED.

The various seeds and plants distributed by the Bureau during the past year may be classified under the following heads: (1) General farm-crop seeds; (2) maguey plants; (3) garden vegetable seeds; (4) flower or ornamental-plant seeds.

General farm-crop seeds.—Distributions of farm seeds of especial interest were field corn, sesamum, Carolina golden rice, and peanuts. A considerable amount of the corn distributed was produced at the Singalong experiment station, where, for the first time, we succeeded in raising seed corn that was in all respects fully up to the standard of the type procured from the United States. A part of the sesamum seed distributed was acquired by purchase, and a part was donated to the Bureau by M. Edoard Vidal, of Manila, who selected the Bureau of Agriculture as the medium for the widest and most effective distribution of this valuable oil seed.

Our experiences and those of others have been generally good with broom corn, field corn, cowpeas, velvet bean, kaffir corn, sorghum, rice, and sugar cane. Of cotton, teosinte, and the new varieties of tobacco and peanuts we have not yet received reports sufficient to justify conclusions. Barley and oats fail to produce grain and indicate usefulness as forage plants only at high altitudes. Alfalfas and clovers in the lowlands have invariably died out even where the soils were inoculated with the specific bacteria called for by each species. At high elevation sufficient success has been attained to justify further experimental work with these plants. Rape and rye have been tried only at La Trinidad and data of results obtained have not yet been received.

Maguey plants.—The distribution of Hawaiian sisal plants has had three direct results: It has introduced into the Islands an improved variety of maguey; it has furnished a supply of plants in localities where Philippine maguey could not be obtained; and it has greatly stimulated the planting of our local maguey.

The first lot of 50,000 Hawaiian sisal plants was received in Manila in July, 1906. These plants were distributed in 8 provinces, the distribution being made largely through the provincial governors.

The second lot of 50,000 plants was received in August, 1906. These plants were distributed in 18 provinces, both through provincial officials and direct to the farmers.

The third lot of 120,000 plants was received in November, 1906. Of this shipment 15,000 were sold to the Moro Province at cost price, 10,000 were furnished the Bureau of Lands for distribution on the friar estates, 5,000 were planted at the Lamao experiment station, and the remaining 90,000 were distributed in 33 different provinces. The total number of Hawaiian plants received and distributed during the year was 220,000. In a majority of cases these plants have been distributed through provincial governors, teachers, and other responsible persons. Our records show that 37 provinces and districts, 196 municipalities, and 502 individual farmers have received Hawaiian sisal plants. It has been impossible, however, to obtain complete data on this subject, and the

ultimate distribution of these plants has been much more widespread than is indicated by these figures.

During the past six months we have received many reports stating that the Hawaiian plants have given entire satisfaction, and numerous requests for more plants have been received.

On June 30, 1907, the total number of requests that had been received by this Bureau for maguey plants was 1,342. These requests were received from 43 provinces and districts and from 381 municipalities. In order to supply this demand for maguey plants an order was placed in February, 1907, with the Hawaii agricultural experiment station for 500,000 sisal pole plants, to be delivered in Manila during July and August of the present year.

Garden vegetable seeds.—Unqualified success has been reported from every province, excepting Samar, with the following: Beans, beets, cabbages, carrots, eggplant, mustard, okra, peppers, radishes, parsley, New Zealand spinach, tomatoes, and turnips. Sweet corn, American cucumbers, melons, watermelons, and squashes have been the subject of many conflicting reports, these reports ranging all the way from "very good" to "complete failure." All persons who have had failures, except in growing corn, concur in attributing their losses chiefly to insect enemies, which through ignorance, apathy, or neglect to procure the proper remedies have remained unchecked. Brussels sprouts, rhubarb, and French artichokes, so far as tried, have proved most unsatisfactory. Asparagus has made a very strong growth wherever planted, but since it has no winter resting period here it tends to produce small tips and a heavy growth of plume. Kohlrabi of excellent quality and size was grown by the Bureau experimentally and is deemed worthy of considerable distribution. Celery has made good growth, but has so far resisted all attempts to blanch it without its rusting badly. American peas, if planted so as to mature in our coolest season, invariably fruit, but are not as prolific at low altitudes as could be desired. A few of the edible podded Japanese varieties gave heavy yields, and a large distribution of these varieties is contemplated.

Flower and ornamental-plant seeds.—Heretofore the Bureau has not distributed flower seeds, but as there has been a constantly increasing demand for this class of seeds a small supply was purchased during the past year. These flower seeds have been distributed to 173 persons. The following varieties of flower seeds have been sent out: Amaranthus, balsam, calendula, caliopsis, cockscomb, marigold, portulacca, zinnia, nasturtium, and ageratum. Excellent flowers of all of these, except the last two, have been secured. The failure of the last is remarkable for the reason that a closely allied species occurs as a noxious weed throughout the Archipelago.

NATURE OF REQUESTS.

Two very gratifying features in connection with the seed and plant distribution during the past year are worthy of mention. One is the greatly increasing number of small farmers who apply at the office in person for seeds and the other is the very marked increase in the number of applications which have been received from the Provinces of Samar and Leyte. During the last few weeks of the year there were received a large number of requests from these two provinces for both field and garden seeds. This seems to have resulted directly from the restoration of peace in these two provinces and shows that the people there are now resuming their normal occupations on the farms.

PROPOSED CHANGES.

During the past two years only one distribution of seeds has been made each year, this distribution beginning the latter part of September and lasting through December. At this period of the year conditions prevailing on the west coasts of most of the Islands are best suited to gardening and farming operations. There is a small demand for seeds throughout the year, especially from Americans and school children, but on account of the difficulty of keeping seeds in satisfactory condition, many of these requests have been held over for the dry-season distribution. Now that there is a growing demand for seeds on the east coast of those islands where the seasons are the reverse of those on the west coast, it is thought that a return to the custom of making two seed distributions per annum will be demanded. Two distributions each year will necessitate two importations for the reason that seeds deteriorate rapidly in this country. The difficulties of keeping seeds in perfect condition in these Islands are sufficiently great at best, and it would be inviting certain failure to attempt the distribution of seeds which had been kept on hand a number of months.

STEAM PLOWING.

LANDS PLOWED.

In November, 1906, the large steam plow formerly used at the Murcia rice farm was shipped to the Santa Rosa friar estate with a view to its use in plowing the lands formerly cultivated in sugar on that estate. These lands have been abandoned for about ten years, have become overgrown with a dense growth of the native grasses, talahib and cogon, as well as occasional spots of timber, so that it is almost impossible to break them again with farm animals. There are two classes of land on this estate. The lowlands along the lake shore are of a sandy nature intermixed with silt brought down by the small streams originating in the near-by mountains. These lowlands are generally cultivated in

rice and are so covered with dikes used for retaining the irrigation water that it is impracticable to plow them with a steam plow. The foothills lying between the lowlands and the mountains are of a gentle, rolling nature and of black volcanic formation. There is occasionally a sandy spot or a hill on top of which there is a heavy layer of reddish iron-ore gravel, but in general the soils are black in color, of fine texture, and quite pasty when wet.

OBSTACLES.

An effort was made to use a steam gang consisting of six 14-inch share plows of the sandy land type, the only plow of this kind owned by this Bureau. As was predicted, it would not turn the soil and was soon pronounced a complete failure. An effort was then made to use an 8-disc steam gang. This worked fairly well where the land was sandy, free from grass and trash, and especially where it had been broken once. However, land once gotten into this condition is easily plowed by the use of farm animals, thus obviating the necessity for a steam plow. As this gang was to all intents and purposes a failure, a series of investigations followed in an effort to find a plow which would do this work properly. The result was the building of two gangs carrying 8 and 12 discs, respectively, and a middle breaker each. These gangs have extra heavy frames, triangular in shape, and the drawbars are attached to the base of the triangle. The middle breaker, with a heavy wheel in the rear, is at the apex of the frame. An equal number of discs are set on each side, one-half of them turning the dirt in one direction and the other half in the opposite direction. Each gang has three wheels, all of which are adjustable by levers and are used for regulating the depth of the cut. The large gang cuts a swath 12 feet wide or 4½ feet more than the gang of six share plows, and is apparently drawn by the 35-horsepower engine as easily as the latter. The small gang cuts about 8 feet and was made for the 18-horsepower thrashing engine, which had been sent to Santa Rosa from Cavite Province. It has, however, proven too heavy, and two of the discs have been removed, thus decreasing the cut to about 6½ feet. Both gangs have been pronounced by the farm machinery expert of this Bureau a decided success, and, while the most valuable part of the dry season for steam plowing was consumed in making the experiments, it seems probable that we are now prepared for such plowing as may be demanded in the future. Many difficulties have had to be met and overcome in connection with steam plowing, among which is the inability of the landowners to do a reasonable part in connection with the work and the necessity for accomplishing practically everything at Government expense. It was originally intended that the landowners should furnish the labor, haul the water, and furnish the fuel, which latter was to consist of dry wood cut in the vicinity. The labor they have furnished has been quite

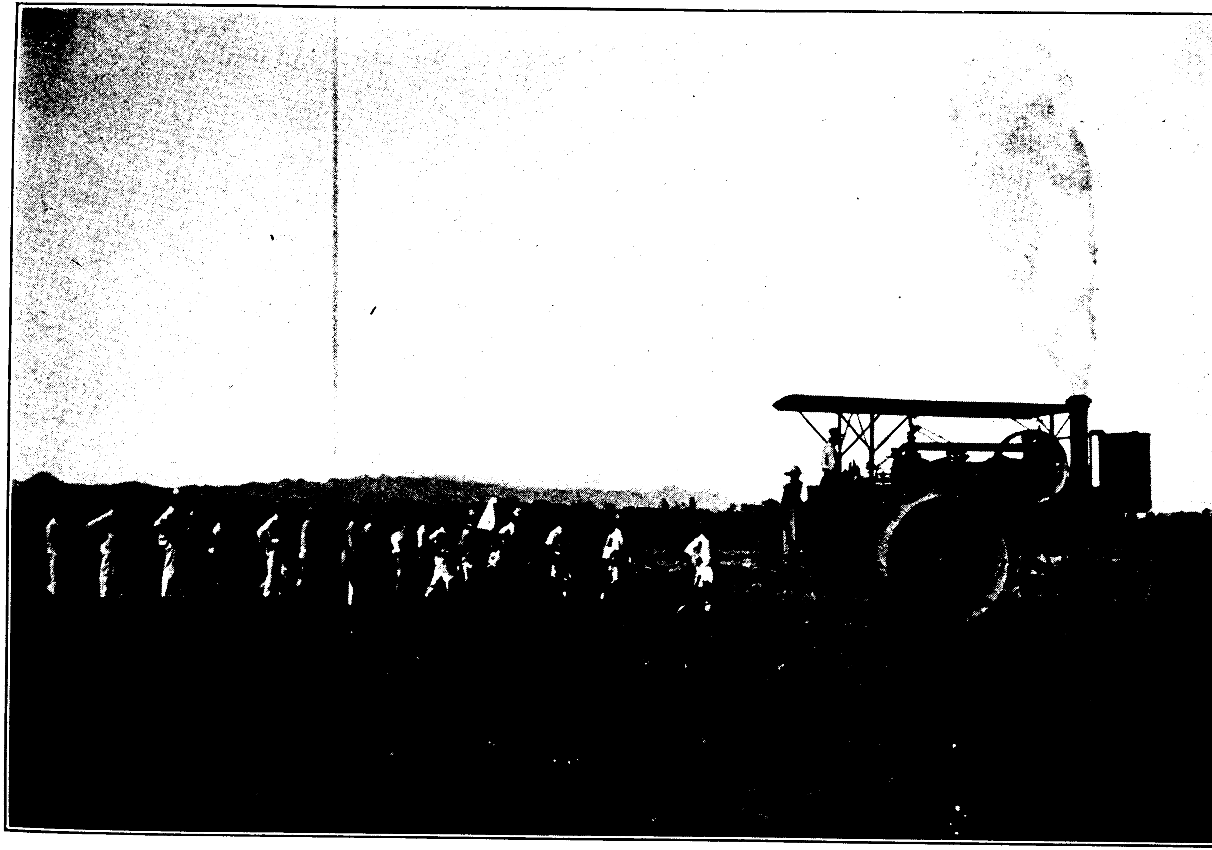

PLATE II.

unsatisfactory for the reason that most of the plowing is being done quite a distance from where any people live. The laborers have not as a general rule camped with the plowing outfit, but have returned to their residences in the barrios at night and have been correspondingly late reporting for duty the following morning. Animals for hauling wood and water have been quite scarce and the available supply of dry wood was soon exhausted. It is not practicable to cut and cure wood except in the dry season, and as this work has been neglected, the continuation of plowing operations with only wood as a fuel seems impracticable. Realizing these difficulties, the landowners sent a delegation to Manila with a request that the Government supply the necessary fuel and charge it as a part of the expense of plowing the land. The price at which this Bureau agreed to plow the land, with labor, fuel, and water furnished by the landowners, was ₱5 per hectare. To furnish coal as a fuel for this plowing will practically double the expense, and as it will also be necessary to put a trained force of hands, paid and subsisted by the Government, on each of the plows, it is feared that steam plowing will cost more than the landowners will feel justified in paying.

PROSPECTS.

There has been a constant demand for steam plowing on other friar estates and private lands in the provinces lying near Manila. It is not thought wise to encourage the people to believe that this work is an entire success in view of the difficulties which this Bureau has had to contend with during the past year. If the infective animal diseases constantly destroying the domestic animals used for draft purposes on the farms could be placed under control, even to the extent of making it reasonably safe to import cattle, it is probable that plowing with animals would be a better method of reclaiming the uncultivated lands than to freely advocate steam plowing.

ADVICE.

A number of trips of investigation have been made by the Assistant Director to the different friar estates and several private haciendas for the purpose of advising the landowners relative to improvements on the same. One trip made to the Imus estate, where there was considerable demand for steam plowing, developed the fact that there was no road over which a steam plow could be taken before reaching the lands where the plowing was desired, and that possibly three-fourths of these lands were overgrown with timber and brush to such an extent that the operation of a traction engine was practically out of the question. The owners were furnished with stump pullers and advised to clear the land from timber and make an effort gradually to bring it into cultivation by means of domestic animals.

A trip was also made to the friar estates lying immediately northeast of Manila with a view to investigating the character of the land

that recommendations might be made regarding the most desirable crops to be planted there. These estates are not, as a general rule, adapted to the growing of rice and sugar cane on account of the extremely shallow soil and scarcity of irrigation water. They are, however, admirably adapted to the growing of maguey, kapok, ilang-ilang, and such other crops as are not exacting in the matter of soil and water.

The Muntinglupa estate was visited in the month of October, 1906, and after a careful investigation recommendation was made that all of the unleased portion of this estate be surveyed into large blocks and offered for lease and sale for the purpose of planting maguey. This suggestion was adopted by the Bureau of Lands and practically all of the land was leased by the end of the fiscal year.

LOANS OF ANIMALS FOR BREEDING PURPOSES.

The Bureau of Agriculture has continued to furnish American stallions, jacks, bulls, and boars for breeding purposes in the provinces. In many cases the number of services rendered by these animals has not been as large as could reasonably be expected. This fact has been due to several different causes, among which are the following: There is a notable lack of appreciation of the value of better blood. In some cases horses stationed in the best horse-breeding districts have had practically no service, while hundreds of mares in easy reach were running at large with a herd of horses containing numerous native stallions of all ages and qualities. In many cases the native owner of mares does not even take the pains to breed them to the best native ponies. During the year 11 stallions and 2 jacks have rendered 228 services. Of these, 1 Arabian stallion in a remote mountain district has served 62 mares, 2 in charge of the Bureau have served 75, and the remaining 10 have served only 91, or an average of only a little over 9 each.

The groundless fear that native mares would not foal colts sired by larger horses has also continued to exert a bad influence. In other cases horses have been loaned to private parties whose interest in their use did not extend beyond the breeding of their own animals, and under such circumstances no effort has been made to secure outside mares to be bred. There have also been circulated various rumors, such as the charging of extortionate stud fees or the taking of part of the colts by the man having the horse in charge, all of which no doubt have had their influence in deterring those who might otherwise have patronized the horses.

A number of excellent colts have been reported during the past few months. No systematic inspection of the foals has yet been made, but this work will be undertaken during the coming dry season.

Three of the stallions have been taken out of private hands and placed in charge of employees of the Bureau of Agriculture. The persons having charge of these horses have been instructed to campaign them

and to obtain, if practicable, full service lists for each one. It is believed that this method will give better results than any other and that it should be adopted in the future, as the horses are liable to die at any time without having rendered a satisfactory amount of service. It will be somewhat expensive to handle the stallions in this way, but the good work they are capable of doing and the amount of money already invested in them are sufficient reasons to justify such expense.

There has been a constantly increasing demand for American and Australian bulls, and, while but few have been furnished the past year, this is one line of public service which will be pushed in the future. A number of excellent young bulls are now being raised. All of these bulls have been, or will be, immunized to rinderpest and sent to provinces where their services are likely to be of the most value.

During the first five months of the year the prospects for a further distribution of Berkshire pigs seemed very bright, but, on account of the advent of cholera among them the latter part of November, the entire lot except six sows died. About four months' time was lost in obtaining another good boar from Australia, and it will be well into the next fiscal year before we shall have another lot of pigs ready for sale or distribution. There is a constantly growing demand for pigs, and, while the people generally have no disposition to pay fancy prices for them, there is a reasonable appreciation of the fact that well-bred pigs are superior to those of the native type.

We have also had a number of requests for the loan of Angora and Maltese milk goats, but up to the present time have been able to furnish only one Angora and two Maltese billies for public service.

There has been a small demand for poultry, which has generally been met by directing the inquirer to local dealers who have poultry for sale. As the few chickens still owned by the Bureau of Agriculture have been loaned to another Bureau we have not been able to supply this line of live stock.

FARMS ABANDONED.

Two farms have been abandoned during the year. One of these was the dairy farm operated at San Juan del Monte near Manila, where the dairy herd had been kept for a little more than two years. The area of land available at San Juan del Monte was small, it was very stony, and was rendered dangerous for cattle by the large number of stone quarries scattered over it; furthermore, the land was in litigation and the courts have since decided that it is not the property of the Government. The dairy herd was moved from there on December 29 to a place selected for a new dairy farm on the Muntinglupa friar estate in the southern portion of Rizal Province.

The other farm that was abandoned was a tract of about 25 hectares of land on the Santa Cruz friar estate in Cavite Province which was

under cultivation in rice. A part of this piece of land was plowed by means of a petroleum traction engine which this Bureau was testing, and the remainder was broken with the 18-horsepower thrashing engine which had been sent to San Francisco de Malabon in connection with the rice-thrashing outfit belonging to this Bureau. A strong prejudice had grown up there against the work of the thrashing machine which made it impracticable to operate it during the last harvest season. The exact cause for this prejudice is not known, but is reputed to be a superstition or belief that rice thrashed on the machine is in some way injured so that it produces a low-grade product in milling. It was not the intention of this Bureau to plant the land plowed, but to lease it to small planters residing on the friar estate. As no applicant appeared to take it and as we had just imported a large supply of Carolina golden rice, it was decided to plant this rice at Santa Cruz and to produce seed for distribution. It was not known at the time that the Carolina golden rice was a short-season variety and would not stand transplanting. The result was that, although the plants grew very rapidly in the seed beds, when transplanted they failed to recover from the dwarfing effect. The harvest was less than the seed sown and was pronounced a decided failure. At the same time a considerable quantity of this rice was sown in drill at the Singalong experiment station in thin sandy soil and produced at the rate of 52 cavans per hectare without artificial irrigation. At the time the thrashing engine was removed from Santa Cruz all of the machinery and implements used in the cultivation of the rice were shipped back to Manila.

NEW FARM ESTABLISHED.

One farm has been opened during the year. It is known as the Alabang stock farm, and, when thoroughly equipped, all of the live stock belonging to the Bureau of Agriculture which has been kept in a number of places in and around Manila will be taken to this farm.

MACHINERY INVESTIGATIONS.

The absence of the machinery expert of this Bureau who was in the United States from the beginning of the fiscal year until December has seriously handicapped our machinery investigations. Some progress has been made, however, in this work.

ABACÁ MACHINES.

There has been more definite progress made during the past year in the work of perfecting and introducing abacá-cleaning machines than in any previous year in the history of the Islands.

The development of the "Welborn-Bracy" abacá cleaning machine, of which mention was made in the last annual report of the Bureau of Agriculture, has been continued by the company which controls this

PLATE III.

machine. The essential principle of this machine is that it cleans the fiber by means of knives on revolving wheels. A machine considerably larger than the original model has been designed, and the first of these larger machines was completed during the month of April. The weight of this machine is about two tons, its operation requires from 12 to 15 horsepower, and it can not be considered as belonging to the class of so-called "portable" machines. A contract has been let for the construction of ten more of these machines, which are to be built in Manila, and the owners of this patent seem absolutely confident that they have a thoroughly reliable machine.

In October, 1906, a prospectus was issued by the proposed Manila Hemp Machine Company in which it was stated that the original Welborn-Bracy machine would clean 1,000 pounds of dry abacá fiber in ten hours. This cleaning capacity has not been fully realized, however, since the machine has been placed in the field. The engineer who has operated both the original and the improved machine states that the latter has been given a test run of eight hours, during which time 625 abacá stalks, yielding 432 pounds of dry fiber, were cleaned. This gives an average of 54 pounds per hour, or 540 pounds per day of ten hours. It should also be said to the credit of this machine that its capacity depends largely on the skill of the operators, and that these results were obtained in a locality where labor is very scarce and inefficient and where many of the laborers had never seen a machine of any kind in operation before. The engineer claims that after this labor has been trained for three or four months, he will be able to clean from 60 to 80 pounds of fiber per hour, or from five to six piculs per day of ten hours.

There has also been considerable development in the construction of abacá-cleaning machines which use the old principle of cleaning the fiber by means of a fixed knife. One company now has several such machines in operation in the Province of Albay. Another company, capitalized at ₱150,000, has been organized for the purpose of manufacturing and placing on the market a machine of this type. Several other different abacá-cleaning machines are either in course of construction or are ready for trial tests.

The Bureau of Agriculture has continued to furnish such assistance to the inventors and owners of abacá-cleaning machines as has been practicable. Raw material has been supplied for making trial tests, and these tests have been made, when so requested, under the supervision of the fiber expert. Samples of machine-cleaned fiber have been sent to many of the leading cordage manufacturers in the United States, and reports and opinions regarding the fiber have been obtained. These reports indicate that there is no ground whatever for the belief that the fiber is injured by the machine during the process of cleaning.

KAPOK MACHINES.

A machine for cleaning kapok, designed by the Assistant Director, was partially constructed early in the year. This machine was a combination of the cotton gin and thrashing machine. The work was discontinued to take up a method of cleaning kapok suggested by the Director in which a small portable thrashing machine was used. This machine was modified by placing on it a suction feed which carried the kapok directly into the cylinder. The lint, seed, and burrs were, however, discharged together and much of the work of separation had to be done by hand.

MAGUEY MACHINES.

The large amount of maguey planted during the past year, and the prospective development of this industry in the Philippine Islands, indicate that there will be a considerable demand for maguey-cleaning machines in this country within the next two or three years. The greatest obstacle to the introduction of maguey-cleaning machines in the Philippines at the present time is the fact that our maguey industry is not sufficiently developed to use advantageously the large machines which are in general use on the plantations of Yucatan.

The Bureau has furnished information in regard to the development of our maguey industry to the leading manufacturers of fiber-extracting machines in the United States, and advices have been received from one of these companies that a trial machine would be shipped to the Islands. One of the small "Pioneer" sisal-cleaning machines was received by the Bureau just at the close of the fiscal year, but it has not yet been placed in operation.

RICE MACHINES.

Three different kinds of cylinder rice hullers and polishers have been tried and the results have been quite unsatisfactory. It is probably not entirely fair to charge this failure to the machines, as they have been successfully operated in the United States and in a few cases in the Philippine Islands. The proper cleaning and polishing of the Philippine rice crop is quite a problem on account of the large number of varieties grown, the difference in size and texture of the grain, and the various methods of harvesting and handling. Enough information has been gained, however, to warrant the conclusion that burr hullers are better adapted to present conditions in the Philipine Islands than the more modern cylinder hullers.

BROOM-MAKING MACHINES.

The farm-machinery expert of this Bureau was instructed to investigate the broom-making industry during his vacation in the United States. The success already obtained in the growing of broom corn and the production of high-grade brush seemed to indicate that the manufac-

ture of brooms could be made a profitable small industry here. During the time that our representative was studying the industry in the United States this subject was brought to the attention of persons here who were thoroughly conversant with broom manufacture. They at once took the matter up and began operations in a small way. Sample brooms of three grades have been received at this office and are unquestionably equal to any brooms produced in the United States. There is not a very extensive market in the Philippine Islands at the present time for this kind of brooms, but the industry is one which can be enlarged by developing an increased demand for the product.

DIVISION OF PLANT INDUSTRY.

This division includes all general plant investigations, laboratory and field tests of seeds, and the work done at the Singalong experiment station, Manila; the Lamao experiment station, Bataan; the Baguio experiment station, Benguet; the La Carlota sugar farm, Occidental Negros; and the coffee experiments at Lipa, Batangas.

FIBER INVESTIGATIONS.

MAGUEY.

OUTLINE OF WORK.

The extension and development of the maguey industry has been an important line of work of this Bureau during the past year. An attempt has been made to do four things: First, to show the farmers throughout the Islands the value of maguey as a Philippine crop; second, to supply plants wherever they could be used to good advantage; third, to establish a nursery which should furnish a future supply of plants for distribution; fourth, to introduce into the Islands a maguey-cleaning machine suited to the conditions which exist here.

EDUCATIONAL.

Maguey is widely distributed throughout the Islands, but a year ago the value of this plant was not generally understood and, excepting in two or three provinces, but little of it was being planted. To-day there is not a municipality in the Islands where maguey is unknown, and this crop has been, and is being, planted in every province where conditions are suitable for its cultivation.

Early in the year the Bureau published, in English and Spanish, a bulletin on the cultivation of maguey in the Philippine Islands. Five thousand copies of this bulletin have been distributed. During the year we have published circulars on maguey in English, Spanish, Tagalog, Ilocano, Cebuano, Boholano, and Masbate dialects 27,000 copies of which have been distributed. It is believed that this circular, which is a simple catechism on the elementary facts relating to maguey cultivation, has

been most effective in producing results. In addition to general distribution, these bulletins and circulars have been furnished the Bureau of Education for use in the schools. This distribution of printed matter has been supplemented by a large amount of correspondence on the same subject, and many planters from the provinces have come to Manila and have visited this Bureau for the purpose of obtaining information regarding maguey. This educational work has prepared the way for the systematic extension of maguey planting in every municipality in the Islands where this crop can be profitably grown.

ABACÁ.

ABACÁ WASTE.

During the year ending August 31, 1904, this Bureau took up the question of the utilization of abacá waste for the manufacture of paper. Samples of this waste were collected and analyzed, and other samples were sent to a large number of paper manufacturers throughout the United States, France, and Great Britain. This waste was tested and reported upon by a number of manufacturers and considerable interest in the subject was aroused. This work has been continued up to the present time and has also been the subject of extensive investigations by the Bureau of Science. As a result of these efforts a company has been formed for collecting and shipping this material, and abacá waste is now one of our export products.

FOREIGN MARKETS.

The great bulk of the abacá produced in this country is shipped to foreign markets, and practically none of the producers of this fiber are in any way in touch with the manufacturers and consumers in the United States and Great Britain. As questions frequently arise relating to the quality of fiber received, the relative use of abacá and other fibers, and other allied subjects, it is desirable that such information be obtained from the manufacturers and brokers as may be of value to the Philippine farmers, and that we furnish the former with such information regarding the industry here as may be called for. This work has been carried on as in previous years by means of correspondence, reports, and samples sent to, and received from, the leading manufacturers and fiber brokers in the United States and Great Britain.

PROVINCIAL INVESTIGATIONS.

In October, 1906, the fiber expert made a trip through Albay, Ambos Camarines, and Sorsogon principally for the purpose of making stripping experiments with different varieties of abacá. Several of the largest plantations in these provinces were visited, and eleven stripping tests

PLATE IV.

were made. The time alloted for this trip was insufficient to allow of thorough work being done in any one province, and the almost continuous rains greatly interfered with the drying of the fiber that was cleaned. Considerable information was obtained, however, and this work is to be continued during the coming year.

A thorough investigation of the leading varieties of abacá in all of the more important abacá-producing provinces should be a work of great value. At the present time we know that the fiber of one province sells for ₱16, and that of another province for ₱26, but to what extent the quality of fiber produced is affected by the variety of plant grown is not fully known. If we have certain varieties greatly superior to others which are in general cultivation the fact should be known and these superior varieties given wide distribution. Such an investigation will require considerable time, as we have dozens of different varieties of abacá, scores of local names, and practically no reliable botanical data regarding abacá on which to base these investigations.

GROWING ABACÁ FROM SEED.

The growing of abacá in commercial quantities from seed has an important bearing on the industry on account of the limited supply of abacá suckers in certain provinces. In Mindanao some planters report the demand so great that they are finding it more profitable to sell abacá suckers at prevailing prices than to grow the plants for fiber. Of three lots of seed obtained the past year, two large lots proved defective, less than 1 per cent germinating. From a small (150 grams) sample, the very good germination of 60 per cent was obtained. The high winds of the dry season scorched and killed off many of the young plants, but 700 survived, were twice transplanted, and then sent to the Lamao station in Bataan for permanent planting. At the time of removal the stems of these seedings averaged 3 feet 6 inches in height and were correspondingly stocky and vigorous. The seeds were planted October 14, 1906, and the plants set out permanently June 1 of the present year, thus demonstrating that abacá plants may be obtained from seed in seven and one-half months. Some plants that were slightly protected were of suitable size for permanent planting inside of six months from time of seed sowing. The soil and climatic conditions in Manila where these experiments were conducted were exceptionally bad, and there is no doubt that under favorable conditions the results, including germination, would be much more satisfactory. The procuring of seed is sometimes a matter of much difficulty, as abacá plants are usually cut before the seed matures. Planters who desire to follow this method of propagation can do so by reserving a few fully mature stools of the plant which will produce all the seed required.

KAPOK.

ESTABLISHMENT OF EXPORT TRADE.

We have found in the case of abacá waste that when a demand for this material was created the establishment of an export trade soon followed. It is believed that the same will be true of kapok and with this end in view we have been in correspondence during the past year with a number of the leading buyers of kapok in the United States.

Samples of Philippine kapok have been sent to these parties and the reports on these samples have, in general, been very favorable. The latest report received states that well-cleaned Philippine kapok would be marketable in New York City at 14½ cents, United States currency, per pound. The firm making this report states that it would be prepared to make a contract for all the kapok that the Philippine Islands could produce. Another firm in the United States with which we have been in correspondence has recently placed a preliminary order for a ton of Philippine kapok. The export trade in kapok is now handled by two reliable business firms in Manila to whom are referred such inquiries as we receive on this subject.

LOCAL DEVELOPMENT.

The development of the kapok industry in these Islands calls for two things, viz, the saving of the large quantities of kapok now allowed to go to waste and the increased planting of trees. The value of this fiber is not generally understood throughout the provinces, and there is great need for educational work. Arrangements have been made for carrying on such work along the same lines that have given satisfactory results with maguey. A circular, giving concise and elementary information in the form of a catechism, has been prepared. This circular will be published in English, Spanish, and the more important Philippine dialects, and will be widely distributed throughout the Islands. In connection with this work kapok seeds and plants will be distributed to all persons requesting the same.

MISCELLANEOUS FIBER PLANTS.

There are a great many different plants in the Philippine Islands which yield fibers that would be of value if produced in large quantities and their use once established. The fact remains, however, that any attempt to introduce a fiber that is not already well known in the commercial world is a slow, costly, and, ordinarily, an unprofitable task. We receive many samples of such fibers with inquiries as to their value and possible utilization. Where these samples are of such quality as to justify such action, they are forwarded to fiber brokers in the United States and Great Britain and reports obtained.

Very excellent specimens of "Anabo" (*Abroma augusta*) have recently been received from the province of Iloilo and have been forwarded to

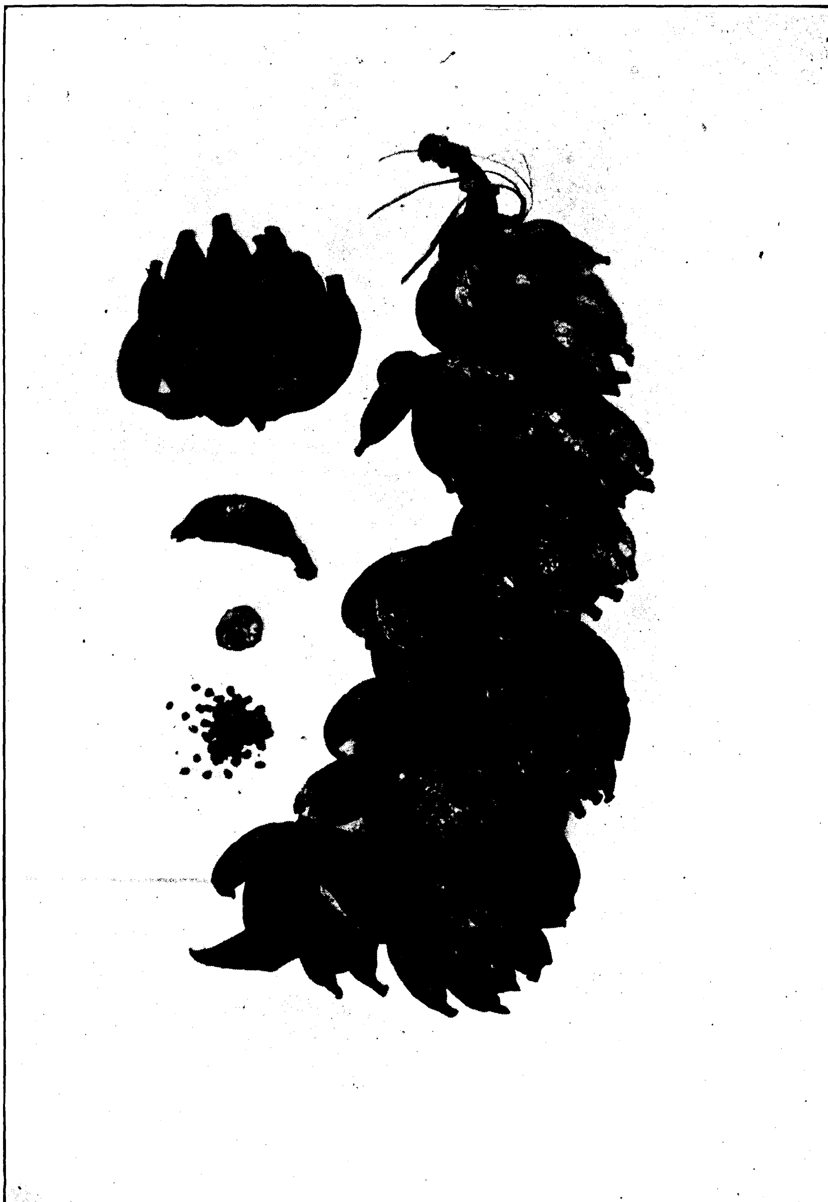

PLATE V.

the United States for examination. This is one of our promising local fiber plants, as it is widely distributed in the Islands, requires little cultivation, and produces a fiber of fairly good quality.

Specimens of "Sunn hemp," grown at the Singalong experiment station, were forwarded to American manufacturers earlier in the year, but the reports received were not of such a nature as to encourage the further cultivation of this plant.

With conditions favorable for the production of abacá, maguey, and kapok, for which there is practically an assured demand at good prices, it is believed that the cultivation in more than an experimental way of other fiber-producing plants that are not so well known should not be encouraged.

FIBER EXHIBITS.

On February 13, 1907, we forwarded to the Pacific Commercial Museum, in connection with a general exhibit of agricultural products, an exhibit of Philippine fibers and fiber products. This exhibit included 10 sample bales of abacá, showing the fiber of different provinces; 22 specimens of abacá from the Moro Province; selected samples of machine and hand cleaned abacá and maguey; kapok, cotton, and cocoanut fiber; and a very fine collection of textile fabrics.

We have received during the year a collection of abacá samples from the district of Davao, and other samples of minor importance.

SEED AND PLANT INVESTIGATIONS.

SEED-PRESERVATION EXPERIMENTS.

Some original laboratory work has been carried on during the year in the preservation of seeds. The results already achieved promise to solve a problem which for many years has been vexing importers and handlers of seed in all hot countries where the minimum atmospheric humidity never falls below 55° and the mean normal for one-half the year approximates 85°. Hermetical sealing, while a protection to the seeds in transit, is of no assistance after arrival unless the seeds can be disposed of as soon as opened, which is of course impracticable for merchants and others handling seeds in large lots. The difficulty of preserving the vitality of seeds in this country is indicated by the fact that pease, which on arrival from the United States gave us an 84 per cent germination test, failed entirely thirty days later. Corn, cotton, and other oily seeds have deteriorated within three weeks.

The experiments described below were conducted with a lot of very fine American corn seed received here early last December, and which showed the remarkably good germination average of 95 per cent. The object of these experiments was to determine the value of the method of keeping seed in hermetically sealed jars as compared with the method used in this Bureau. Three 2½-pound lots of the corn were taken

at random from the shipment. One lot was placed in an ordinary metal seed canister with a reasonably close-fitting cover. A second lot was placed in a glass jar provided with a close-fitting ground-glass stopper and at once hermetically sealed with melted paraffin. The third sample was put in a similar jar in which had been placed an inch of coarsely broken charcoal that had just been exposed to a heat high enough to expel the moisture. While the charcoal was still warm, the corn was poured in and the whole topped off with another inch of charcoal. While still open it was exposed for thirty minutes to a gentle heat (43°–C.) and then carefully sealed. This was on December 23, 1906. On May 23 of the present year (six months later) the two jars were opened and 100 seeds taken from each, a like number were taken from the closed canister, and all were placed in the germinators. These tests were concluded on June 1 and we obtained from the heated jar containing the charcoal a 91 per cent germination, from that only hermetically sealed a 28 per cent, and from the canister a 36 per cent germination. The tests were sufficient to demonstrate that hermetical sealing unless precautions are taken to expel the very moist atmosphere is detrimental rather than beneficial to the seeds. The unusually good showing (36 per cent) of the unprotected seeds was due in part to excellence of vitality at the start, and still more to the abnormally low reading of the hydroscope and the high, dry winds which marked the first quarter of the present year. Since the beginning of the wet season, however, the exposed corn has deteriorated more rapidly than that which was merely sealed. At the conclusion of the tests the heated corn was treated anew in the same manner and will be kept for future tests of this method. The average life of most garden and field seeds in temperate climates, without other provision than a cool, clean, dry bin, is four years, the extremes being two to ten years. These tests demonstrate the possibility of preserving all seeds even under the trying conditions which prevail in these Islands. It is obvious that the importation of seeds of good quality is an indispensable factor to successful preservation and that the cost of the method of seed preservation herein described would be great for large quantities of seeds, as they would have to be placed in small jars and much charcoal would be required. Large containers might be used, but, as it would be difficult to fully exhaust the damp air and to promptly seal such containers, the danger of loss would be increased. The tests which we have made indicate that seeds from temperate countries can be preserved in the Tropics by the method described, although the use of this method on a commercial scale may not always be practicable.

SEED TESTING.

Our seed distribution began October 10, 1906, and all seeds were tested previous to their distribution. Most of the small seeds were

received from Europe and came packed in hermetically sealed zinc cases. A number of varieties of pease, beans, and corn were received from American dealers and came in empty spirit casks.

Of the 23 varieties of vegetable seeds received from Europe, all, with the exception of lettuce, showed an excellent percentage of germination, notwithstanding the fact that they were seeds of the preceding year. The failure of the lettuce is possibly attributable to the exposure of this seed to excessively high temperature during shipment.

The American pease, beans, and corn all responded quickly to germination tests, with the exception of the lima beans, which proved to be defective.

The office germination tests were in every case confirmed by field trials at the Singalong experiment station. The two defective varieties were also given field tests, but were not distributed.

We have received a smaller number of complaints about defective seeds than in previous years. Reports have been received, however, that our tomato, pepper, and cabbage seeds were entirely worthless. In a number of cases we have been able to furnish young plants grown from the same lot of seeds to the persons making these reports.

Experiments conducted in Manila show that perfectly fresh seeds of many plants are affected by extremes of either drought or moisture. At altitudes of 4,000 to 5,000 feet these conditions, if accompanied by low soil temperatures, are still more unfavorable for germination. Tomato and eggplant seeds planted at Baguio in January, 1904, failed to germinate and were pronounced defective. Early in May of the same year, when the seeds were four months older and presumably not improved by age, they germinated freely. Unfortunately the demand for vegetables at Baguio comes at a time which necessitates planting the seeds during the coolest season of the year, corresponding to midwinter in the United States. At this season heavy fogs and even frost are frequently seen, and ice has been reported in the mountains near Baguio. The soil temperature is evidently quite low, vegetable growth is very slow, and seed germination correspondingly uncertain.

The climatic condition, intelligence of the farmers, and many other things that affect plant growth vary so widely in the Islands, and even in the same province, that great care has to be used in sending out seeds if favorable results are to be expected.

EXPERIMENT STATIONS.

SINGALONG EXPERIMENT STATION.

SOIL.

The soil at Singalong is very sandy. This is due to the fact that the station grounds face on a large salt estero, or tidal creek, and are only about one-half kilometer from the shore of Manila Bay. Slightly below

the surface the washed beach sand formation is clearly visible. The soil is very porous and the water readily percolates down to the water table, which is, however, very near the surface during the rainy season. There is no place on this station that is over 2 meters above sea level.

WATER SUPPLY.

There is a 6-inch artesian well at Singalong in which the water comes within a meter of the surface. Just below the water level in the well it is connected across to an overflow cistern having a capacity of 15,000 gallons. A 6-inch duplex pump is so connected that it will take water from the well, from the cistern, or from both, as desired. A storage and pressure tank with a capacity of 6,000 gallons, elevated 8 meters, furnishes the means of securing water on all parts of the grounds, to which it is carried through a system of pipes beginning with 3-inch pipes and running down to 1. A small 8-horsepower steam engine is used for running this pump, and from about the middle of December until the middle of May it is operated every day to furnish water for irrigation purposes. On account of the limited water supply no flooding can be done, but the water is conducted through trenches which have been puddled to prevent rapid waste in the sandy soil.

CROPS.

Guinea grass.—A few roots of this grass received from Honolulu, twenty of which arrived in good condition, were propagated by division. It has proven very successful, and at the present time there is about half a hectare of plants growing at the Singalong station grounds. In addition, a sufficient surplus has been grown to make liberal experimental plantings on the stock farms at La Trinidad and Alabang, from both of which places come encouraging reports of its vigorous growth. A small amount of the tops have been used as green forage, and were relished by the animals, being eaten up clean by both horses and cattle. Although two cuttings of forage have been made from the original plants, and a third is well advanced toward maturity, they give no indications of exhaustion. The necessity for frequent subdivision for propagation has prevented the taking of any yield records. It can only be said, therefore, that appearances indicate a large forage yield per acre.

Paspalum dilatum.—This water grass, seeds of which were procured from Australia, has made a very satisfactory growth. It is reputed to endure more drought than the species of *Paspalum* found in the Philippines, and we shall propagate it extensively during the coming year.

Corn.—On account of the small size of the station grounds, it has been found impracticable to grow more than one variety of corn at a time. The principal variety produced this year was Moseby, the seed of which was obtained from Mississippi, in which state it was originated. This corn has retained its characteristics in succeeding generations better than

PLATE VI.

PLATE VII.

any other variety we have so far grown. It is a white corn with very deep grains and small cob. These characteristics are just the opposite of most native corns, and the Moseby would no doubt be excellent to cross with them. Several small lots of seed were selected, cured, tested, and distributed in the Islands. No yield tests were taken, as most of the corn grown was sold to be used as roasting ears. Small plantings of sweet corn were made, but were very much dwarfed and became mixed with the Moseby corn. Corn grows best here in the dry season with artificial irrigation. The growing of green corn for the Manila market might be made a thriving and profitable industry. There is a large demand for this product and there are many locations along the Pasig River where an unlimited supply of fresh water is available. In some of these locations pumping machinery is already installed for the irrigation of zacate.

Broom corn.—Renewed experiments were made with this sorghum during the year and some very fine samples of "brush" obtained. Our demonstrations have advanced far enough to indicate that broom corn may be grown as a succession crop almost throughout the year. Brush which was taken during the rainy season does not appear to discolor or stain, and this will permit of production for broom making over a long period.

Sorghums.—The original types of sweet sorghum, as well as the nonsaccharine Kaffir corn, Milo maize, and Egyptian corns introduced by the Bureau, have all been grown at the Singalong experiment station grounds, but, owing to the limited area available and the necessity for close planting, these various sorghums have interbred freely. We have a large number of natural hybrids, which, in addition to the races mentioned above, have a strain of broom corn, as well as a sprinkling of *Sorghum negrosensis,* a native species which has been grown to determine its forage value. Some of these hybrids are remarkably robust and more productive of forage than any of the pure races. In yield and quality of seed they seem defective, and it will be necessary to reimport pure seed and cultivate the different varieties on separate farms in order to continue the production of pure seed for distribution.

Velvet beans.—We have continued planting the Florida velvet bean (*Mucuna utilis*) at all seasons; while it never fails, it is a slow grower, requiring about five months to reach maturity. The beans are borne in small clusters at the base of the vines where they never completely dry and are difficult to harvest. They have not proven very prolific and the cost of producing seed is considerable. The best result obtained with this crop during the past year was when planted in the same rows with sorghum and Kaffir corn. The bean vines run up the sorghum and both are then cut for green forage. This pruning seems to strengthen the beans in the further production of runners.

This Bureau has brought into cultivation a native velvet bean, *Mucuna lyoni*. This was a wild and, until recently, undescribed species found in the Pampanga Valley. It is quite distinct from the Florida velvet bean and is readily recognized by its larger and much lighter colored leaves, large woody main stems, and abundant succulent branches. The flowers, instead of being dark colored and growing in closely compacted bunches, are pure white or greenish white and hang in long, open racemes. From the three original seeds obtained, which weighed 2 grams, 7.04 kilos of seed were grown. The three plants were trained upon trellises and were stimulated in every way to the maximum of production. From a subsequent field test alongside of the Florida velvet bean and grown under like conditions, the product of the Philippine velvet beans was the greater. It has now been grown to the third generation, is losing the woodiness of the main stem, and continues to be very prolific. *M. utilis* is edible but so unpalatable as to be classed only with stock foods. *M. lyoni,* although it cooks rather dry, is quite palatable and a great improvement on the former. Tests made at the Bureau of Science proved this bean to be without any trace of hydrocyanic acid, a poison which often occurs in tropical beans in deleterious quantities. Samples of the seed have been furnished the Bureau of Plant Industry of the United States Department of Agriculture in sufficient quantity for field tests in the Southern States and such other investigations as they may desire to make. In general vigor and productiveness of forage, as well as seed, it far surpasses *M. utilis.* Inasmuch as soil-renovating crops also serve to repress cogon and other gross weeds and furnish both animal and human food, these crops must play a highly important part in Philippine agriculture. This fact makes the discovery of *Mucuna lyoni* an economic benefit of signal value.

Sesamum or liñga.—Further work was done with this oil-seed crop to determine the season when its planting would be attended with least risk from loss. In rich soils it makes so rank a growth that it is apt to lodge during heavy rains when approaching maturity. On the other hand, a liberal supply of water is necessary for the production of a good crop. The first trial made at the opening of the dry season resulted in a dwarfed growth and a very inferior crop. From a planting made in June, 1906, we harvested a grain product at the rate of 473 kilos per hectare. Some grain was lost by lodgment from the heavy rains of September, but the amount was small and certainly less than one-fifth of the total. From this it seems better to take the risk of loss from rain rather than to invite the more complete failure resulting from drought. The Philippine Products Company has declared sesamum to be the most tractable oil seed which comes to their hands, and it is our aim by further experiments and distribution of seed to promote

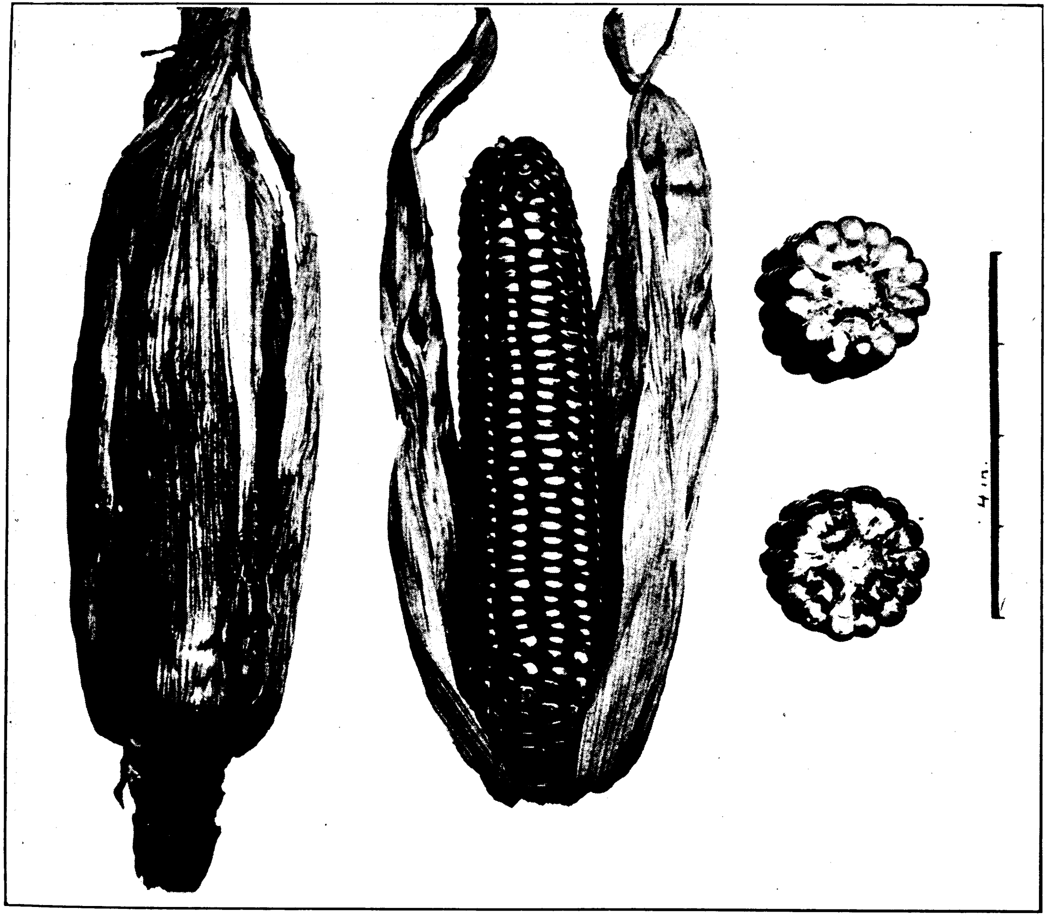

PLATE VIII.

PLATE IX.

this industry as a promising source of revenue to the small native farmer.

Carolina golden rice.—As the result of favorable preliminary work, further experiment and a wider scope of introduction were carried on with this grain. A plat of it sown in drills 18 inches apart, on July 13, was cultivated very much as corn, had no artificial irrigation, headed up in ninety days, was harvested in one hundred and twenty days, and yielded on thin, sandy land at the rate of 52 cavans to the hectare. In the rice experiments, one of the aims of the Bureau has been to reduce to something like uniformity the great number of varieties of rice grown in these Islands. In Carolina golden we have found a variety which is of good size and form, very early, prolific, of excellent milling properties, and uniform in ripening. It is a lowland rice, but can not be transplanted to advantage. The native farmer being accustomed to transplanting all lowland rice, the distribution of Carolina golden must be made with caution and preceded by educational work pointing out the radical changes in method of planting required. As rice is the most important of our cereal crops, and as Carolina golden appears so nearly to meet the standard of requirements, it is desirable that we make long-continued experiments both with this and other varieties.

Tanias.—The single bulb of this promising variety of "taro" or "gabe" obtained from Porto Rico three years ago has proven very prolific and has furnished sufficient "sets" to permit of planting more than 150 linear meters of rows. From this it appears that a considerable public distribution can be made next season. Our previous experience, that this species of *Xanthosoma* will produce a good crop with less water than the *Colocasias* grown here under the name "gabe," is confirmed, and the indications are that this plant will be a useful addition to our list of staple food crops not dependent upon irrigation.

"Venezuela black bean."—This is a species of *Vigna* received, under the above name, from Herbertshoe, New Guinea. It appears to be one of the cowpeas, and closely resembles the "clay pea" of Louisiana. After three months it is yet unproductive, but has made phenomenal growth of vines.

Avocado pear.—The largest tree at the Singalong experiment station flowered quite freely during the past season, but failed to set any fruits. Anticipating this as a possibility, a considerable number of flowers were carefully pollinated by hand. As this method also failed, the indications are that the plant is possibly self-sterile. During the year other plants have attained to flowering size, and the result of cross pollination is awaited with much interest. A few avocado pear trees planted at Lamao made such superior growth that we have recently set out an orchard of half a hectare at that station.

Vanilla.—Some vanilla plants brought here a few years ago were lost in the typhoon of September, 1905, and in view of the depressed condition of the vanilla industry no efforts were made to reintroduce the plant. A few were received as exchanges about a year ago and were planted out at the Singalong experiment station. They have grown exceptionally well. Some of the plants have made leaders 3 meters long and are quite robust. This rate of growth is unusual, even in Vera Cruz, where the plant is supposed to attain the highest degree of perfection. It probably indicates that the conditions about Manila are very favorable for vanilla growing and that the distribution of these plants is to be recommended.

Monstera deliciosa.—Three cuttings of this unique and excellent fruit-bearing vine were received from Brazil nearly one and one-half years ago. One died, and the other two remained dormant for eight months, but then started to grow. They are now well-rooted, are making a strong growth, and there is reason for believing that the introduction will prove successful.

Pineapples.—A few of the Natal pineapples brought here from Durban have fruited. In tenderness and in freedom from fiber and core they are a marked improvement over the Bulacan variety which has been grown at Lamao. We have lately secured 200 plants of the variety grown in Marinduque and have planted them out along with the West Indian varieties now growing at Singalong. This makes five kinds we now have growing at this station, viz, Smooth Cayenne, Ripley, Red Spanish, Natal Canning, and Marinduque. The trials proposed include fertilizer and irrigation tests, determination of the relative yields and quality of fruit of the different varieties and the production of plants for distribution.

Coffee.—The small planting of maragogype hybrid coffee made in Lipa, Batangas Province, four years ago produced last year a first crop of a little more than 1 pound of berries to the tree. Although not immune to the leaf blight, it is so strongly resistant to the disease and has survived so well in that pest-afflicted region that the berries were all quickly bespoken by old coffee planters of the district, quite a number of whom have planted seed beds for the purpose of renewing their plantations. As this seed was quite unfit for planting, it is difficult to avoid the conclusion that some future disappointment is in store for these planters whose enthusiasm has outstripped their knowledge or wisdom. The few trees at the Singalong experiment station are of the same age, and are equally as good as the plants at Lipa, notwithstanding the unfavorable environment.

Cassava.—Small plantings of the native white cassava were made with a view to testing its growing period, yield, and composition. This

PLATE X.

PLATE XI.

variety seems to reach maturity in about ten months. No satisfactory yield tests could be made on account of the constant depredations of hogs running at large in the city at night. A number of samples analyzed contained about 28 per cent of starch, which is 2 per cent more than is credited to this root in Florida, where it is grown extensively for the manufacture of starch. Cassava is now receiving some attention from prospective manufacturers of starch and tapioca in this country. The following food analysis of cassava shows it to be a valuable root-crop food, especially for hogs and cattle:

Cassava analysis.

	Per cent.
Protein	1.5
Carbohydrates	25.2
Fat	.2
Fiber	2.3

Native squash.—Renewed plantings were made this year with a native Melopepo secured the previous year in La Laguna Province. The quality of this fruit is unexcelled by any known native or exotic cucurbit, but the latest trials confirm its scanty bearing habit, and the defect is one we have been unable to overcome through cultivation. On this account, further work will be discontinued. The brilliantly variegated greenish yellow leaves of this plant are so unique as to suggest its cultivation as an ornamental plant.

Toñgo.—This is the native name of a most excellent yam brought in February of the present year from Mindoro. The tuber is not so nearly spherical as that of the variety found in Luzon and is slightly less glutinous than our common yam. It has much greater mealiness when cooked than *namé, tugui,* or any of the yams in common use here. In view of the very great confusion existing in Dioscorea, and pending Dr. Prain's revision of the genus, it would be premature to say that this is a new species.

As it was obtained under forest conditions, it has been a little slow in adapting itself to cultivation in Manila, but since the advent of the rains has taken a new and more promising start.

Condol (*Benincasa cerifera*).—This was grown as a trellis plant, and from a single vine 62 fruits were obtained. Chinese buyers are always on the alert to procure this fruit. The average yield of a single plant of Benincasa is about six fruits, and the extraordinary yield cited above was due to the exercise of a slightly modified system of pruning practiced, though rarely, by Filipino gardeners. It consists merely in splitting the main stem and leading branches and inserting wedges, which procedure has the effect of checking leaf growth and developing flowers. In addition to this, "pinching back" was practiced with the result mentioned above.

Parameria vine.—Cuttings of this rubber plant, brought from Mindoro in February of the present year, successfully rooted and are now growing nicely. The seeds of Parameria are small, and development by that method of propagation tedious, hence the experiment of determining if, by the use of cuttings, rapid multiplication could be secured. The botanist of the Bureau of Science was unable to determine the age of the samples of vine brought in, but the indications point to its very early development, probably in one or two years from cuttings if planted under suitable forest conditions.

Laboratory analyses show the dry bark of this vine to contain 4.52 per cent of pure caoutchouc. It is, however, associated with oils and resins which, when extracted, leave the rubber tacky and of low value unless vulcanized. The vine is too small to be successfully tapped, but the uncontaminated rubber can probably be obtained by a centrifugal or other mechanical process. As 1.48 per cent of the live weight of the plant is rubber, and as small parcels of the wild vine produced at the rate of 4 tons per acre, there is a theoretical yield of 120 pounds of rubber to the acre.

The questions to be determined in regard to Parameria are, first, a suitable extraction process, and, second, the time required to secure a crop.

Maguey.—The small plats of native and Hawaiian maguey growing at the Singalong experiment station have continued to flourish, notwithstanding the fact that they are on low, level land, almost at sea level, and where no special provision is made for drainage. During the year all of the Hawaiian maguey was removed to the border of the land where drainage was possibly a little better than in the center of the plat where it was formerly planted. Part of it was set under the shade of clumps of bamboo and part in the open. Where it had strong sunlight and was not crowded, it has made a very satisfactory growth, the leaves being about a meter long, though it is not yet 3 years old. The leaves are far superior in shape and development to the native maguey, which has a thin leaf tapering from base to point with such rapidity that the leaves do not attain the desired weight. Both kinds have produced an abundance of strong, healthy suckers, which have been distributed.

SILK CULTURE.

Near the close of the fiscal year this Bureau, in connection with the Bureau of Science, started a series of experiments in silk culture.

The results thus far obtained are not sufficiently complete to justify a statement as to the probable success of this industry in the Philippine Islands.

PLATE XII.

LAMAO EXPERIMENT STATION.

SOIL.

That part of the Lamao Forest Reserve under the control of the Bureau of Agriculture is located principally near the shore of Manila Bay and on the Lamao River. A considerable portion of the land now in cultivation is hilly and broken.

The soil is for the most part underlaid with drift bowlders, cobble stones, and gravel, and varies from red clay to beach sand, including all varieties of sandy loam. In many places it is so porous that there is difficulty in conducting irrigation water across it without puddling the ditches or fluming. The unused land is overgrown with a dense growth of brush which necessitates considerable work in clearing and makes cultivation difficult until the roots and stumps have all been gotten out.

WATER SUPPLY.

The Lamao River has several branches originating in the mountains just back of the station, and they furnish an abundant supply of water to irrigate all of the land now in cultivation. Irrigation water is secured with perfect ease, requiring only a temporary dam of bowlders taken from the stream and a small ditch leading down to the fields.

BUILDINGS.

All buildings at this station are of a temporary nature except a small office near the bay shore. Toward the close of the year a large nipa house for the superintendent was begun at Station One near the beach. As there is no other place in this vicinity where botanists, foresters, and other scientific investigators can find suitable quarters, sufficient room is being provided to accommodate them in the superintendent's house.

White ants are numerous at Lamao, and buildings, bridges, and other permanent structures require constant repairs to keep them in order.

CLEARING AND FENCING.

During the year about 4 hectares of land have been cleared, fenced, and brought into cultivation. All new land put under cultivation requires thorough fencing on account of wild hogs, which are very numerous and constantly destroy nearly all kinds of cultivated crops.

NURSERY.

There was considerable decrease in nursery work on account of the fact that the demand for economic and ornamental plants was not as great as had been anticipated. The facilities at this station for the propagation of forest trees, ornamental plants, and flowers are almost unlimited. It is believed that the growing of such plants might be greatly encouraged by the production of a liberal supply at Lamao for free distribution to municipalities and schools throughout the Islands.

CROPS.

Coffee.—Among the more interesting things growing at this station during the year might be mentioned a plat of coffee. A part of this has been irrigated and has made an excellent growth, while the unirrigated portion has done only fairly well.

Rubber.—A planting of 400 Brazilian rubber trees was made in the brush land with a view to determining whether or not they are capable of making satisfactory growth without clearing the land. These trees have done very poorly and will probably have to be removed to prevent their entire destruction. A few trees of the Mexican rubber planted at this station under more favorable conditions have done quite well.

Avocado pear.—Avocado pears have done specially well, and a plat containing almost one-half hectare has been planted out.

Maguey.—In addition to the 20,000 maguey plants previously put out at this station 5,000 Hawaiian sisal suckers have been planted during the year. All of the maguey is making a very satisfactory growth, and in the course of two years more there will be an abundant supply of suckers for distribution. This crop has proven a very easy one to handle on these broken hill lands, where nothing more was done than to cut down and burn the brush, set the plants out at the proper distances, and afterwards keep the weeds and sprouts cut down to avoid shading the plants.

Abacá.—Mention has already been made of 700 abacá plants produced from seed and set out at this station. Abacá of other varieties will be added and grown under the same conditions so as to test their comparative merits.

Kapok.—An experimental planting of young kapok trees was made at Lamao in thin but uncleared forest. The trial was made to determine if this plant would hold its own in competition with the native woodland or jungle growth. The trees have survived the first dry season, which, under such conditions, was perhaps all that was to be expected. Seed plantings were also made to determine the relative loss or gain in time over planting truncheons or cuttings of the stem or branches. This seed sowing was made in mid-September, 1905, and at the close of the present fiscal year, when only 20 months old, a number of the plants are over 6 meters in height and have a girth measurement of 40 centimeters at a height of 30 centimeters from the ground. Some of the trees planted at Lamao produced pods in less than two years from the time of planting. This information is of considerable importance, as there are localities where kapok does not occur, and in any case the procuring of large cuttings and their transportation to distant points would deter many from planting. This experiment has definitely established the fact that planting upon a large scale may be cheaply and expeditiously effected by sowing seed.

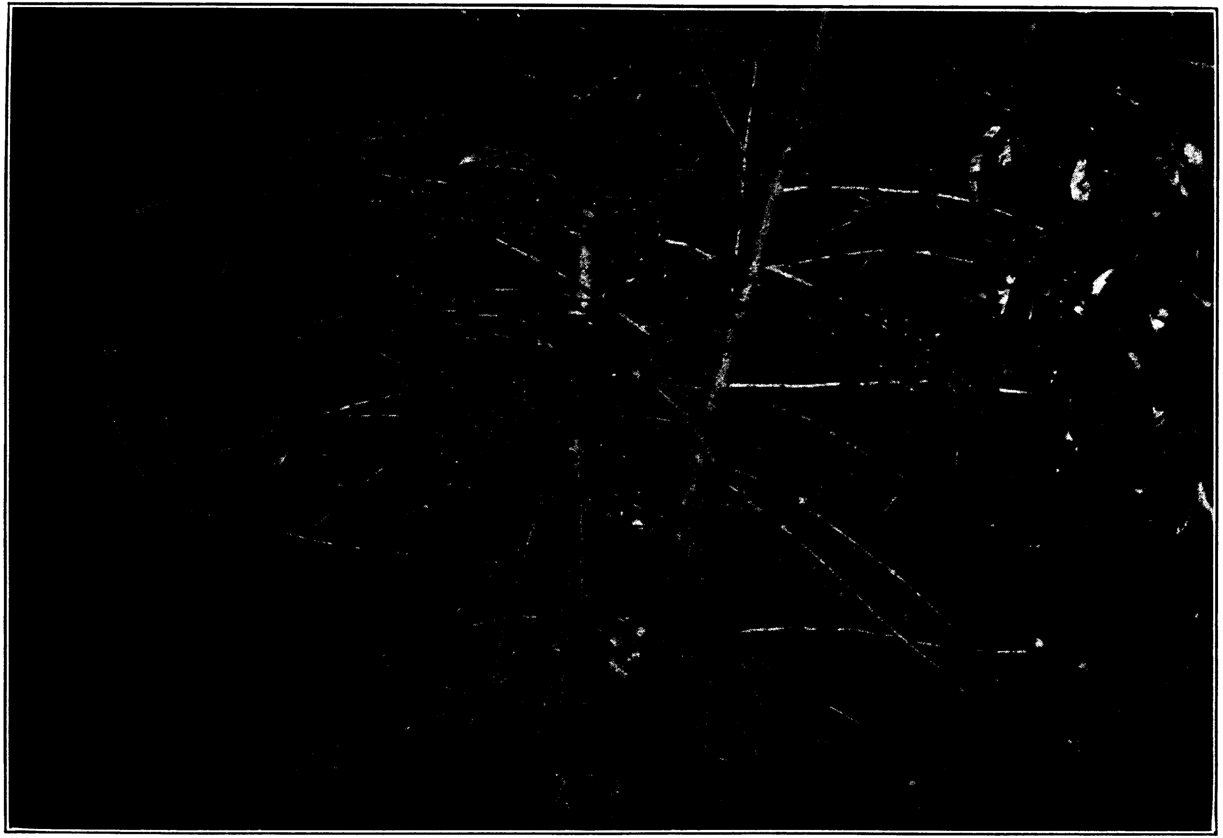

PLATE XIII.

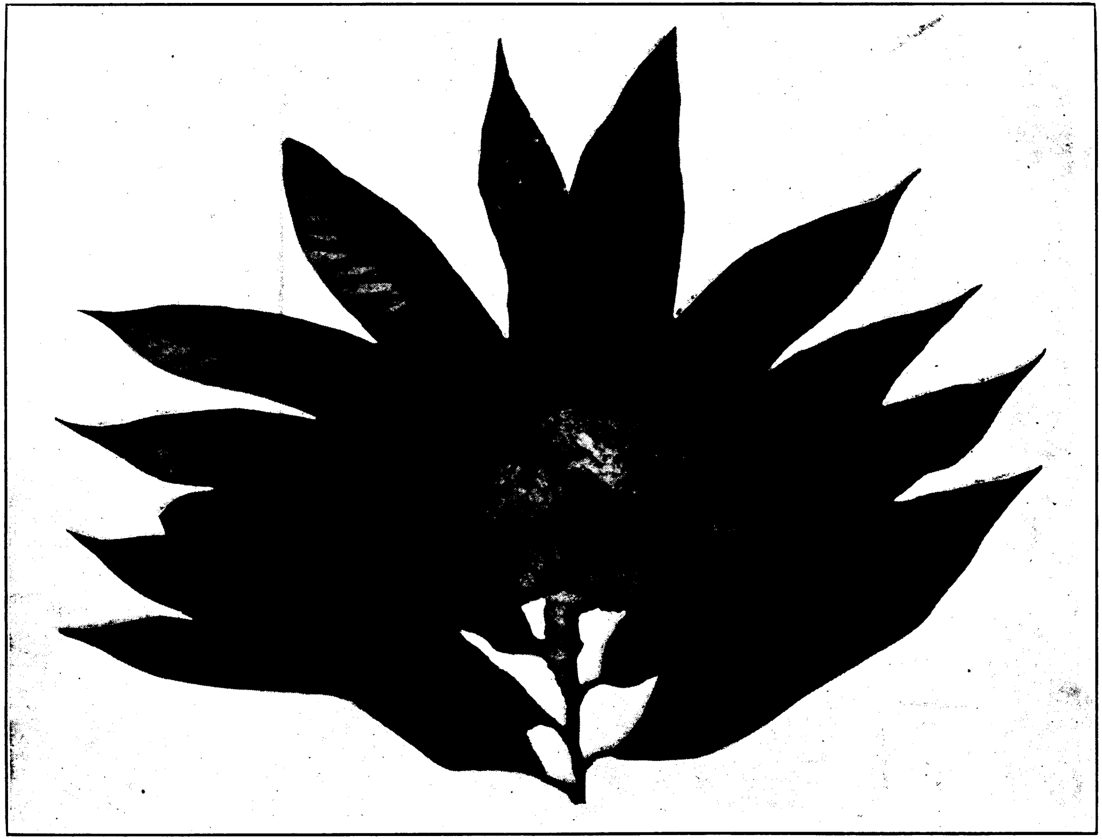

PLATE XIV.

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at all fertile and will require a judicious application of manures and chemical fertilizers and the growing of leguminous crops in order to bring it up to a satisfactory state of productiveness.

CLIMATE.

This province has a temperature reaching the frost line in midwinter and a rainy season a little earlier than that of the west coast of the Islands—that is, beginning in May and ending in October. On account of these facts this section of the Philippines promises to be a favorite resort for those seeking health and pleasure. Ever since the summer capital of the Islands was established at Baguio there has been considerable demand for fruits and vegetables during the dry season, especially during the months of March, April, and May. The climate at this season is delightful to the tourist, but in order to produce vegetables to be available at this time of the year they have to be planted early, when the daily minimum temperature goes down almost to the frost line. This has proven to be a condition making it possible to grow all of the early spring vegetables of the United States in this section, but those things which flourish best during summer weather, such as corn, can not be successfully produced at Baguio during these months.

WATER SUPPLY.

The water supply for the station was secured by constructing a temporary dam of bowlders in the Balili River and conducting the water in an open ditch which follows the road through the valley.

OPERATIONS.

This station up to the beginning of the past year was operated in a small way with a view to obtaining experimental information with reference to the crops suited to this section of the Islands and incidentally for the production of vegetables for sale to those frequenting this resort during the dry season.

The plant breeder of the Bureau was sent to Baguio in February, 1906, and was placed in charge as superintendent at the beginning of this fiscal year. The operations of the station have since been greatly increased. The irrigation system has been extended, sod lands put under cultivation, roads built, and drainage ditches put in. An extensive system of variety tests, germination experiments, plant-breeding work, fertilization, cultivation, and rotation has been established. Practically every crop in the Philippines is now being tested at Baguio, and other economic plants are being brought from different parts of the world for trial.

PLANT BREEDING.

The present superintendent has not been at Baguio a sufficient time to obtain definite results in his plant-breeding work. The hybrids thus far produced have not reached the desired characteristics, being mostly in the second generation.

Considerable attention has been given to the improvement of the wild Rubus and wild strawberries, as these plants are already growing in great abundance in the vicinity. If they can be improved in productiveness, size, flavor, and resistance to disease by hybridizing, cultivation, or otherwise, they will prove a valuable addition to that section. New types of Rubus and Fragaria are being evolved, and considerable improvement has already been produced in the species of wild raspberry which has been brought into cultivation.

California lemons and oranges have been grafted on to the native citron and promise excellent results. This work is of special value in view of the fact that the native citron is already acclimated to that section and is able to withstand the heavy rains of the summer months. This citron can also be propagated by cuttings and shows resistance to fungus diseases.

Wild blueberries placed in cultivation have improved greatly in size and flavor and the bearing period has been very much prolonged.

A tomato which is thought to be resistant to damage by excessive rainfall has been produced by crossing the native tomato with an improved variety.

By a system of root grafting and training, young mulberry trees have been made to produce fruit within a few months and the berries appear to be much improved in quality.

There are many other lines of plant breeding in progress which will be reported on more extensively during the coming year. Free use is being made of selection, crossing, hybridization, budding, grafting, and cultivation in the improvement of plants.

CROPS.

Potatoes.—Potatoes have been the subject of considerable experimenting, as this is one of the staple crops grown by the Igorot. Four varieties have been tested during the wet and dry seasons, and while the yield has been rather small the quality of the potatoes produced was excellent. The low yield was no doubt due in a large measure to the poverty of the soil which can be overcome by proper fertilization. This is one of the most promising crops for the Province of Benguet.

Vegetables.—Nearly all of the standard varieties of vegetables, including pease, beans, tomatoes, spinach, cabbages, turnips, carrots, lettuce, kohlrabi, peppers, radishes, eggplant, beets, cucumbers, native onions, squashes, garlic, and mustard, have been successfully grown at this station during the past year. The following vegetables have been grown in a small way and most of them are worthy of further consideration: Rhubarb, half a dozen plants, growing nicely; celery, grows slowly, is fibrous, does not blanch satisfactorily; Brocoli and cauliflower, varieties grown not satisfactory, better varieties will probably succeed; artichokes,

very young, but doing well. The seeds of muskmelon and watermelon failed to germinate.

Small fruits and berries.—Strawberries: Only a few varieties thrive and set fruit. The American varieties without runners have given best results. One of these varieties is an ever-bearing, large-fruited, somewhat crested variety of excellent flavor, with firm, dark-red fruit; the other is a smaller variety with bright-red, oblong berries. The names of these two varieties are not known. The French variety, "Reine de prairie," the principal one now in cultivation at Baguio, is a small ever-bearing variety with an erect stem. It has given only a light yield, but can probably be improved in this respect by proper fertilization. Raspberries: A few plants of American and Australian varieties are growing nicely, but have not yet reached the fruiting age; the native red, yellow, and black raspberries are now being cultivated with a view to their improvement and are fruiting freely; three plants were recently received from the United States and are to be used in cross breeding with the native varieties.

Fruits.—Citrus fruits: About 2,000 seedlings and cuttings of the native citron are growing nicely and are to be used in budding and grafting work with improved varieties of oranges and lemons. Deciduous fruits: The apple, pear, plum, quince, apricot, and peach trees bloomed and set fruit which dropped very early; one Australian chestnut is reported as in bloom and one English walnut tree is alive and gives some promise of growing. Grapes: A number of imported and native varieties are growing fairly well, but are too young to determine results; two of the Concord vines flowered, but failed to set fruit. Japanese persimmons thrive very well. Loquots are promising. Coffee: The nursery contains a large number of seedlings; coffee grown from cuttings promises to give fruit much earlier than that from seedlings. Figs: Cuttings are growing nicely.

Field crops and forage plants.—Corn: White dent variety produced very small yield in rainy season, the only time of year when this crop succeeds at all. Sorghum: Grows very slowly, but produces a fair crop of forage in six or eight months. Millet: Fairly satisfactory. Oats: The best green forage crop yet grown; sown in October they yield a fair cutting by March, but do not produce grain; sorghum and oats have so far furnished the bulk of the green forage produced at this farm. Rye: Makes light growth, but produces small amount of grain. Barley: Generally unsatisfactory, Chevalier variety grows best, but produces no grain. Wheat: Practically all varieties failed except red Fife and Triticum durum, which produced some grain. Flax: Very promising; grows well during both rainy and dry seasons; seeds freely and fiber seems of excellent quality. Castor bean: Thrives well and fruits at all seasons. Sunflower: Fairly successful. Alfalfa: Has given two

cuttings in five months; in flourishing condition, promises well; the plats have not been inoculated, but show a small number of root nodules. Vetches: Smooth vetch has made fair growth; seeds abundantly and promises excellent results; hairy vetch shows a more fibrous growth, but does not produce seeds. Clovers: Volunteer plants of red, white, Trifolium repens, and Medicago lupulina have made vigorous growth and seem worthy of further planting. Sanfoin: Slow grower; not promising. Bermuda grass: May be regarded as native, as it grows freely throughout the Trinidad Valley and flourishes better during the dry season than any grass there. This will probably be the standard pasture grass of the higher altitudes, like Baguio, as well as for most of the lowlands in the Philippines.

OBSTACLES.

In addition to the poor soil, cold seasons, and heavy rains, the plants grown at this station have had to withstand the ravages of a large number of insects. These insects attack practically all of the vegetables, fruits, berries, and even field crops. Fungus diseases have also caused much damage to potatoes, tomatoes, pease, and a few other crops, but have generally been susceptible to control by spraying with Bordeaux mixture.

Much of the land was in sod, and it has required a great deal of labor to bring it in cultivation and provide the necessary irrigation and drainage. The conditions at this station are probably more favorable for growing many crops and vegetables introduced from the United States than any other farm operated by this Bureau. It is located in the heart of a section occupied by one of the primitive tribes of the Islands, and every success there means much more than it would in the more enlightened sections. On account of the remoteness of its location, the operation of this farm is necessarily expensive, but a reasonable expenditure seems justifiable in view of the possibilities existing. Baguio is one of the stations from which we expect great things in the future.

BUILDINGS NEEDED.

It will be necessary during the coming year to erect permanent buildings at the Baguio station, as the temporary grass structures used heretofore are now practically useless on account of decay. It seems especially desirable to construct a greenhouse in which seeds can be propagated during the cold season for transplanting in early spring.

LA CARLOTA SUGAR FARM.

LOCATION.

This farm is located in the foothills of the Volcano Canlaon, about 6 kilometers east of the town of La Carlota, Occidental Negros. It is in the best sugar-growing province of the Philippine Islands, where it was established by the Spanish Government as an experiment station for the study of the sugar industry.

SOIL.

The land at the La Carlota farm is undulating on the lower levels and rather hilly farther up the mountain sides. Much of it is underlaid with drift bowlders, cobble stones, and gravel, with a superposed stratum of soil of black volcanic matter resembling in many respects the lands of the Middle Western States. Along the streams the soil is all washed off of the rocks, so that in many places near the streams cultivation is out of the question. The soil of this farm is considered excellent for sugar growing, and the results obtained may be taken as a fair sample of what can be accomplished on the best sugar lands of the Islands.

WATER SUPPLY.

A river of considerable size bounds the farm on one side and there are several smaller streams within the limits of the farm. A dam has been constructed in the larger river and a canal built which carries the water a considerable distance from the stream where it enters a tunnel through which it passes down to the sugar mill, where it is used to produce the power required for milling the cane produced on the farm. A branch of this canal carries the water out farther on to the farm, where it becomes available for irrigation purposes. Much trouble has been experienced in attempting to use the water of this river for irrigation purposes, as the hacenderos having mills farther down the river complain that there is a lack of water for power when it is used for irrigation purposes higher up the stream.

EQUIPMENT.

The sugar-manufacturing equipment on this farm is of the antiquated type in use in the West Indies about forty years ago. It consists of a 3-roller mill operated by water power and a train of open kettles through which the juice passes as it is being made into sugar. This equipment was found on the farm when it was turned over to the Bureau of Agriculture. It has been operated there because of lack of means to purchase any other, and for the reason that the condition of the sugar industry in the Philippines is not such as to encourage a large expenditure in equipping a sugar experiment station.

OPERATIONS.

Up to the present time the farm has been operated only in a small way, less than 100 hectares of cane having been under cultivation. However, this is more than can be handled expeditiously with the milling outfit now provided, as was shown during the past season, when it required from early in December until the 21st of April to mill the small quantity of cane grown. An effort has been made to run the farm on an economic basis, according to the methods generally practiced by cane growers in these Islands, rather than to undertake any elaborate system of experiments which would have cost more money and given less

returns. In fact the great bulk of the crop consists of native varieties of cane, although we have grown small plats of imported varieties. The farm has not been so laid out that the different plats would be comparable, nor has much of the required equipment for experimental work, such as wagon scales and technical apparatus required in the sugarhouse, been provided. An attempt has been made to estimate the crop of cane as accurately as possible and to determine the yield of sugar by actual weights. The best yield yet obtained was from a field of first rattoons, Louisiana striped cane, which produced at the rate of 118½ piculs of sugar per hectare, or 3.3 tons per acre. Most of the imported varieties obtained do not seem peculiarly adapted to the conditions of these Islands. Many of these varieties are canes requiring a long period of growth for their full development. As all canes in the Philippine Islands generally mature off early in the dry season, beginning from November to January, they make the entire growth in from eight to twelve months, averaging not over ten. In other countries many varieties of cane frequently grow from fourteen to eighteen months, and when brought here seem to persist in that habit. The result is that they must be planted very early or they will not mature in time to be milled along with the native cane. This necessitates planting them as early as October or November in order that they may reach full growth. By the end of the dry season they have attained a height almost equal to the native cane at maturity, and while the stalk is of good size near the ground, it tapers off rapidly and becomes very small near the top. When the rains begin the new growth at the top of the stalk develops to normal size, but, having such a small, weak portion below to support it, falls down and becomes badly tangled. Once down and in contact with the ground, it begins to sprout, which destroys to a large extent the sugar-making value of the cane. In some cases it is split or broken off, and stalks so injured begin fermenting and ultimately decay or become an easy prey to insects and ants. Finally when the harvest comes these improved varieties of cane frequently give very poor results as compared with the small native types. It is possible to overcome many of these difficulties by better systems of cultivation and abundant irrigation throughout the dry season, so as to keep the cane in a healthy growing state. Another notable featurer in connection with the varieties of cane grown is that while the native canes will yield a No. 2 Iloilo sugar and rarely run below No. 3, the improved varieties, and especially the plant cane, produce No. 4.

PROPOSED CHANGES.

The work being done with sugar at the La Carlota farm is altogether unsatisfactory, and it would seem better to convert this farm into a general experiment station rather than to continue it as a sugar farm. If such a station were to be established the improved and native varieties of cane could be grown in sufficient quantities for milling tests and for

general distribution of seed on the sugar farms of this and other provinces throughout the Islands, many other crops that this Bureau recommends for crop rotation in connection with sugar growing could be planted, and sufficient information gained to determine the adaptability of such crops to the soil and other conditions of Negros and similar sugar-growing provinces.

It would certainly seem desirable to continue work with maguey at La Carlota. About 2 hectares of Hawaiian sisal have already been planted and it is growing nicely. A liberal supply of abacá was planted on this farm three years ago, a part of which was set out under shade and part in the open. This experiment has been of value as shown by the fact that the abacá planted under shade is doing quite well, while that planted in the open is nearly all dead and the remainder very small. Excellent work could be done with rice, such as the growing and testing of varieties, yields, effect of fertilizers, and the operation of machinery, such as thrashers, hullers, etc. It is not probable that tobacco could be successfully grown at La Carlota on account of the quality of land and nearness to the sea. This farm ought to be particularly suited to live-stock work, especially with cattle, hogs, and goats, great numbers of which could be maintained with but very litle cost other than the fresh green foods produced on the farm. It could also be used as a base for the operations of the forces of this Bureau working in the suppression of animal diseases, and at times might be available as an inoculation station.

DIVISION OF ANIMAL INDUSTRY.

This division includes the veterinary control work, the serum laboratory, the dairy farm at Alabang, the Trinidad stock farm at Baguio, and all general investigations in animal industry. It was formed as a division of this Bureau by Act No. 1407, in which provision was made for the transfer of the veterinary force from the Bureau of Health to the Bureau of Agriculture.

CONTROL WORK.

RINDERPEST.

Most of the work performed during the year has been that of the control of rinderpest, which has been prevalent in a majority of the provinces and still prevails in many localities. The severest outbreak of the year was experienced in the Province of Batangas. The disease appeared in the municipality of Bauan the latter part of June, 1906. No report of it was made until the 31st of July, on which date the provincial governor wired the Executive Secretary. A veterinary force was sent to Batangas and after almost two months' hard work brought the disease fairly well under control. Remnants of the outbreak still exist, however, in the mountainous sections and in adjacent provinces, to

which it spread despite all efforts to stop it. While no other alarming outbreaks have occurred at any one time, serious losses have been sustained in many of the provinces by the repeated appearance of this disease.

It seems highly probable that rinderpest has not prevailed to any greater extent than in former years, but, with the district organization and crop-reporting service, prompt reports are sent in before the outbreaks become general. This fact, together with the reduction in our veterinary force, previously mentioned in this report, has made it impossible to respond to all calls for help. Even the agricultural inspectors have devoted nearly all of their time to the control of rinderpest. The work has consisted largely in serum inoculation of the affected and exposed animals, segregation, the enforcement of such quarantine measures as could be secured through local officials, and a campaign of education of the people in the nature and rational handling of this disease.

A total of 16,495 carabaos and cattle have received the serum inoculation, with 269 deaths, or 1.6+ per cent. The very best of results have been obtained in every instance when the serum method was employed, and it never produces the disease.

Simultaneous inoculation was given to 44 animals, with one death, or 2.1+ per cent.

The greatest economy has been exercised in the use of serum, as only 3,746 bottles have been available for use in the provinces this year. It has been the practice to quarantine infected districts where possible, but the quarantine measures have been in the hands of the local authorities, who have not in all cases fully realized the value of such measures. In the absence of any Insular sanitary law or quarantine measure we have been unable to keep the previously infected districts free from the disease on account of the constant movement of live stock from infected to noninfected districts.

During the rush of inoculations made in Batangas Province from August to November the demand for serum was so great that quite a number of infected bottles were sent out and used, with the result that an alarming number of abscess formations followed the inoculations. The matter was brought to the attention of the Bureau of Science, which, at that time, had full charge of the serum manufacture. On January 1, when the serum herd was transferred to this Bureau, the Bureau of Science was experimenting with the centrifugation and filtration of the serum to insure its freedom from infection. Serum thus prepared was so improved in appearance and gave such excellent results that permanent arrangements have been perfected by which all serum has since been prepared in this way. So far as is known now, not a single ulcer has since resulted from filtered serum. It is also highly probable that its immunizing value has been greatly enhanced, as formerly it often underwent decomposition in the bottles, so that it gave off a decided stench on opening them.

HOG CHOLERA.

Hog cholera has been reported from nearly every province, and this disease has practically ruined the swine industry in the Philippine Islands. It has not received a great deal of attention, owing to the fact that rinderpest has been considered the most important disease which affects our domestic animals, and has claimed almost the entire attention of our small force.

GLANDERS.

A total of 2,816 horses in the provinces have been examined for glanders, 87 of which proved positive. This disease is apparently prevalent in every municipality of the Philippine Islands. Owing to the belief among the natives that glanders is a curable disease, very little headway has been made in controlling it. The animals found positive to glanders in the majority of cases were only quarantined by the municipalities, and if the cases showed a tendency to terminate in a chronic form they were released and sent back to their owners.

SURRA.

A total of 4,852 horses, cattle, and carabaos were examined for surra, 79 of which proved positive. The same measures regarding the positive cases were taken as were adopted with glanders. This disease has not been as prevalent during the year as it was the year previous. The following table shows the number of different species of domestic animals examined for surra:

Animals.	Examined.	Negative.	Positive.
Horses	2,888	2,815	73
Cattle	586	585	1
Carabaos	1,378	1,373	5
Total	4,852	4,773	79

FOOT-AND-MOUTH DISEASE.

Foot-and-mouth disease has been prevalent in a few provinces, but in no instance has it been considered serious.

DISEASES OF FOWLS.

Diseases of domestic fowls have been reported from nearly every province, and thousands of chickens and turkeys have died monthly in each district where the disease has been reported. The principal diseases affecting the fowls are chicken cholera and a parasitic disease which affects the skin around the head and results in total blindness, and, in a large majority of the cases, death.

PORT AND CITY OF MANILA.

INSPECTION ON ARRIVAL.

During the year there have been 93,017 animals inspected on arrival in the port, of which 37,831 were from foreign ports and 55,876 were from interisland ports. Out of the number arriving from foreign ports, 1,744 were quarantined in accordance with the provisions of the veterinary section of the Sanitary Code (chap. 24 of Ordinance No. 86), city of Manila, on account of the various shipments being infected with rinderpest. The cattle were allowed to land and were quarantined in the owner's corral. Permission was given to the owners to slaughter at the public abattoir such animals under quarantine as were not actually infected with the disease. This quarantine has been of invaluable service to the surrounding country, where it has been the custom of the dealers in Manila to ship the imported cattle immediately on their arrival, as it has prevented the wholesale distribution of the disease by the shipment of these infected herds.

The following table shows in detail the port inspection:

Kind of animal.	From foreign ports.	From interisland ports.
Cattle	35,649	2,431
Horses	1,252	1,876
Carabaos	720	1,403
Sheep	27	164
Goats	30	838
Hogs	142	48,230
Other animals	11	144
Total	37,831	55,086

Grand total, 92,917.

Fees.—The sum of ₱15,434.60 was collected as inspection fees and deposited with the Insular Treasurer.

Animals inspected for shipment to the provinces.

Cattle	2,090
Horses	70
Carabaos	397
Hogs	149
Goats	10
Other animals	4
Total	2,720

ABATTOIR INSPECTIONS.

A total of 80,179 cattle, hogs, goats, and sheep were inspected at the public abattoir or matadero, in the city of Manila, for the purpose of

slaughter, of which 76,358 were actually slaughtered and received post-mortem inspection. Of the total number slaughtered, 310 animals were condemned and cremated. The following tables show in detail the ante-mortem and post-mortem inspections and condemnations:

Kind of animal.	Ante-mortem inspection.			Post-mortem inspection.		
	Total number.	Con-demned.	Passed.	Total number.	Con-demned.	Passed.
Cattle	24,301	11	24,290	20,783	10	20,773
Hogs	55,660	10	55,650	55,360	300	55,060
Goats	202	0	202	199	0	199
Sheep	16	0	16	16	0	16
Total	80,179	21	80,158	76,358	310	76,048

Parts of carcasses condemned, miscellaneous:

Cattle	7,384
Hogs	12,796
Total	20,180

The carcasses of the cattle were condemned for various causes, such as rinderpest, tuberculosis, and general bruised conditions. The majority of the hogs condemned were suffering from *Cysticercus cellulosæ,* though a few cases of hog cholera and swine plague were found. Parts were condemned for various local inflammatory processes.

Of late *Cysticercus cellulosæ* have been found at the abattoir to such an extent that it has threatened the pork industry of Manila.

According to the pork dealers who slaughter their hogs at the public abattoir, the great majority of the cyst-infested hogs come from the Province of Batangas, and some of the smaller dealers who buy from that province almost exclusively have been all but forced out of the business in the past thirty days, owing to the large number of hogs condemned because of this disease. This matter was referred to the Bureau of Health for the purpose of finding out the cause of so much infestation and adopting measures that would lessen the prevalence of this malady. As there are no modern sanitary sewage systems in the municipalities in the provinces, swine are looked upon as the natural scavengers and are allowed free access to human excreta, from which source they become infested. The prohibition of this custom might be practical at least in communities where the parasite is prevalent.

Twenty-one horses have been examined for soundness for the different Bureaus and provincial governments, and four horses have been examined with a view to condemnation and slaughter. Twelve horses in the city have been inspected and condemned for glanders, one for surra, one with broken leg, one for lymphangitis, and one for extreme emaciation.

Twenty-one hogs were found dead in the hog market on Calle Azcarraga, and seven have been found dead on ships arriving from other ports.

The veterinarians of the Bureau stationed in Manila have been called upon by several other Bureaus to treat animals suffering from simple diseases. All requests for work of this sort have been complied with without charge.

SERUM HERD, MANILA.

TRANSFER FROM BUREAU OF SCIENCE.

The herd of cattle, equipment, and premises used by the Bureau of Science in the manufacture of antirinderpest serum were transferred to the Bureau of Agriculture on January 1, 1907. It was also provided in the transfer that this Bureau should furnish the Bureau of Science all calves and large animals required in the manufacture of vaccine for the Bureau of Health, for testing antirinderpest serum, and for other scientific purposes. Under this arrangement the Bureau of Agriculture became responsible for the management of the serum herd and all processes required in the manufacture of the antirinderpest serum up to the time it is poured off from the blood clot. It is then delivered to the Bureau of Science for final preparation and cold storage until required in the provinces.

CONDITION OF HERD WHEN TRANSFERRED.

At the time of the transfer the herd contained only 62 serum bullocks, with about half of them producing serum. Most of the others required nearly two months to bring them up to the desired condition for bleeding. This made the amount of serum produced in January and February very small. During the six months 97 serum bullocks were purchased, and of these 7 died, the principal cause of death being the development of rinderpest about the time of purchase. Some bullocks have proven to be immune on arrival and have given excellent results, but the ideal serum bullock is one that is neither immune nor infected when brought into the serum herd. Three very large Australian bullocks were in the herd at the time of transfer, and while they were carried through to completion they never gave good results. They were wild, very hard to handle, and for some unknown reason their blood always gave poor separation. Chinese bullocks cost less, are easier to immunize, are gentle to handle, and give more serum in proportion to cost than did these Australian bullocks. An effort was also made to use bullocks from the Batanes Islands, where rinderpest has never prevailed. The cattle there show a marked strain of the Spanish "fighting-bull" type, are large and handsome, but very wild. Five were purchased, but on attempting to inoculate them they developed a virulent form of rinderpest and it appeared that all of them were going to die. One was used as a virulent blood animal, two died from rinderpest, and the remaining two were left in such a weakened condition as to be almost useless for the production of serum.

The general condition of the herd has been excellent, probably due in part to the fact that a small amount of green forage has been fed constantly. It is a matter of regret that the herd could not be moved to the new farm at Alabang before the close of the year, where it is certain that great economy in maintenance will result.

PRODUCTION OF SERUM.

The total amount of serum produced during the six months ending June 30, 1907, was 534,500 cubic centimeters. The average number of cattle on hand each day during this period was 94. The total number of cattle purchased was 174, the average purchase cost of each animal being ₱77.22.

The total cost of forage for the six months was ₱8,960.14, or an average of ₱0.529 per animal per day. The daily ration was 6 pounds of crushed food and 8 pounds of hay. In addition to this ration a small amount of green forage, probably not averaging more than 2 or 3 pounds per day for each animal, has been supplied from the Singalong experiment station. This would have the effect of reducing the cost of each ration 3½ to 4 centavos.

The amount paid for salaries and wages during this period was ₱5,744.76, making the total cost of serum production ₱14,704.90, and the approximate cost of serum 2.75 centavos per cubic centimeter.

INOCULATION OF CALVES.

It is a common belief of cattle dealers that calves suffer much worse from rinderpest than mature cattle. That this belief is well founded, is one of the interesting facts developed during the year.

The Director of this Bureau undertook a series of experiments during the fiscal year ending June 30, 1906, to prove the converse—that is, to show that rinderpest is similar to Texas fever in that calves will acquire immunity much more readily than mature cattle. For some reason all of the calves imported by the dealers for the first two or three months after the transfer of this work were very young. They often developed rinderpest in twenty-four hours after arrival and despite all efforts the death rate ran high. We then demanded older animals. They were furnished, but many of them proved to be from eighteen months to two years of age and pregnant. The latter almost invariably aborted on developing rinderpest, and many of them died. After many discouragements one dealer imported a lot of 16 particularly fine calves, which he desired to have inoculated for his private herd. He was finally prevailed on to sell them to this Bureau. It was a matter of great surprise to find that after being inoculated for rinderpest they developed Texas fever symptoms, and thirteen of the lot died. It seems evident that they had not been exposed to ticks in China and were not immune to Texas fever.

At another time a lot of calves purchased developed foot-and-mouth disease, simultaneously with rinderpest, which caused a few deaths.

One lot of ten half-shorthorn calves raised at La Trinidad stock farm, Baguio, was inoculated without a single death. If this is an indication of what can be done with native-raised calves having a strain of improved blood, it may yet prove economical to raise all of the calves required in the manufacture of vaccine.

The total number of calves purchased during the six months was 130, of which 42 died. However, in the face of this severe loss the immune heifers are considered so valuable that one cattle dealer has agreed to furnish all calves required in the manufacture of vaccine and will stand all losses by death, provided he shall not be required to pay for feeding them while in charge of the Government, and that all living calves shall be returned to him after being used for the production of vaccine. His offer will be accepted for a limited time to try the system.

INOCULATION OF BULLOCKS FOR PRIVATE PARTIES.

There has been considerable demand from private parties for the inoculation of cattle for work and breeding purposes. In many cases these requests have assumed the form of urgent demands to accept cattle for treatment when affected with rinderpest.

On account of lack of shed and stall room only the following were taken:

Owner.	Number.	Animal.	Condition.	Died.	Immunized.
Roxas	54	Bullocks	All infected and exposed	2	52
Verstockt	24	do	Healthy	2	22
Olegario	5	Carabaos	1 infected, 4 healthy	1	4
Flameño	6	do	Advanced stages of rinderpest	4	2
Lichauco	2	do	do		2
Miller	1	Bullock	Healthy		1
Flameño	3	do	do		3
Do	1	Australian heifer	Advanced stages of rinderpest	1	

CONDITIONS AT CLOSE OF YEAR.

At the close of the year the serum herd contains 107 bullocks and is producing serum at almost double the average rate of the past six months. We have not been able, however, to meet the demand for serum and shall be compelled to further increase the herd. It will also be necessary to make temporary repairs on the sheds, walks, and corrals, which have recently not been put in good condition pending the removal of the serum herd to Alabang. This removal will now be delayed at least half the year on account of the rainy season.

ALABANG STOCK FARM.

LOCATION.

The Alabang stock farm is situated on the Muntinglupa friar estate about 22 kilometers south of Manila, on the west shore of Laguna de

Bay. This location was selected, after more than a year's search, as the most suitable place available for a stock farm in the vicinity of Manila. The Government dairy is now established at this farm, and the serum laboratory will be transferred there when the necessary buildings shall have been erected. The farm, which was established on December 30, 1906, by the shipment there of a herd of 92 cattle, contains 240 hectares, all of which is available either for cultivation or pasture. As there were no buildings at that time, a temporary camp was established.

Alabang is at present reached by lake steamer calling at Muntinglupa, which is 2½ miles from the farm, and from which the Bureau operates a small sailboat. The Batangas line of the Manila and Dagupan Railway has been graded just in front of the farm, and it is understood that this line will be in operation in a very short time. If there is established a favorable schedule on this railroad, Alabang can easily be reached by train in less than one hour from Manila. This will in many respects greatly facilitate the work of this farm, especially in the shipment of milk. We are now able to make but one delivery of milk each day, and the transportation of this milk from the farm to Civil Hospital in Manila requires over five hours.

SOIL.

The Alabang farm lies immediately back of the level rice lands which border the lake shore. This farm contains a small amount of rice land, but the greater part of its area is undulating and hilly, with outcroppings of rock and coarse gravel on top of the hills. The surface soil is underlaid by a heavy stratum of soft, shaley rock, locally called adobe stone. In general, however, the soil is of good depth, fine texture, gray to black in color, and was no doubt formed by the action of Taal Volcano.

WATER SUPPLY.

One local stream runs diagonally across the farm for a distance of more than 2 kilometers and furnishes a fair supply of water throughout the year. Small rivers on the north and south sides of the farm form part of the boundaries. The mouth of the largest river assumes the form of a deep estero, in which the water level of the lake is maintained to within a very short distance of the farm. Should it prove necessary, it is entirely practicable to pump the water from this deep portion of the river to the hills a little farther back, from which it could be easily distributed to irrigate all of the lower lands. A very good site for a small storage dam 12 meters above the lake level has been found. The present water supply is of a temporary nature, consisting of a boiler and a steam pump, used to fill a small tank from the river in the center of the farm. It is contemplated that when permanent buildings are erected an artesian well will be bored near the center of the group from which water may be pumped for the regular supply.

BUILDINGS.

There were no buildings on the farm at the time it was established, but a few grass sheds were soon erected. Since that time five temporary wooden buildings and a bridge across the main river have been constructed, and a contract will be let at once for the construction of a dairy barn with a capacity for holding 50 milk cows. Plans and specifications have already been prepared for a serum laboratory, sheds for 150 serum bullocks, quarantine station, superintendent's house, building for the Maltese milk goats, implement shed, and quarters for laborers. All of these buildings will be constructed beginning at the close of the present rainy season.

LIVE STOCK.

The herd sent to this farm six months ago consisted of 92 head of cattle, mostly young stock; five Berkshire sows were also sent at the same time. Since then 5 cows and calves, 30 head of Chinese cattle, about 20 head of horses, 26 head of Maltese milk goats, 2 Australian Berkshire boars, and 3 sows have been added to the herd, so that now it is assuming the appearance of a stock farm. Among the stock sent to this farm were a lot of Australian heifers received from Townsville last September. These heifers were inoculated against rinderpest, with a loss of five at that time, and after having been sent to Alabang nine more have died of various causes. They have been no exception to the rule that imported European and American cattle having rinderpest suffer severe emaciation and make practically no growth within a year after taking the disease.

INTRODUCTION OF MALTESE GOATS.

The Bureau of Agriculture sent a representative to the Island of Malta in October, 1906, for the purpose of purchasing and shipping to Manila 20 Maltese milk goats. It was known at the time that these goats were the carriers of the infection of Malta fever, and instructions were given to have all animals purchased thoroughly examined and certified free from the infection of this fever before shipment. This necessitated the inspection of several hundred head, the employment of experts, and the use of microscopic and laboratory methods, for the determination of the presence or absence of the disease. The work was beset with many difficulties on account of the ignorance and superstition of the natives of Malta, and it is highly probable that we could never have obtained these goats but for the good offices of the American consul stationed at Valetta. They were finally secured, placed in quarantine, and later shipped by the Peninsular and Oriental steamship *Palmero* by way of Hongkong with a native Maltese goatherd in charge. They fared quite well on the voyage, only one death occurring. Another animal, however, was injured so that she died soon after arrival in Manila. Several kids were born en route and the animals have bred freely ever since their

arrival. Five of the goats died after being sent to Alabang, apparently from eating a poisonous vine growing on that farm. At the end of six months, however, the original herd of 4 males and 14 females arriving in good condition in Manila now includes the total of 28 head. They have apparently done well at all times and give every promise of success. While it is known that some of the goats of this herd will give from 5 to 8 pints of milk per day, this much has never been taken, as it is desired to give the kids a liberal supply to insure their rapid growth and maximum development. These goats are much larger than the common goats, of thin conformation, have a heavy coat of long hair with light brown or liver color and white predominating. It is thought that they will be particularly valuable as milk-producing animals in the Philippines on account of the high price of dairy cattle, the severe losses sustained among such cattle, when imported, and the lack of knowledge among the people regarding the dairy business.

CONDITION OF STOCK.

All of the stock on this farm has kept in excellent condition, although taken there in the dry season and fed only a small amount of grain. The wide strip of land uncovered by the going down of the lake in the dry season has been covered with a good growth of Bermuda and other grasses and has furnished excellent pasturage. The Chinese cattle have not been given any dry feed at all and have done particularly well.

There are now on this farm 14 calves, from a few weeks old to 6 months. They are unquestionably in the best condition of any calves ever raised by this Bureau. The horses so far sent to this farm have been, with a few exceptions, the culls and condemned stock from other farms. If these horses do well at Alabang, it is contemplated that more will be sent there during the coming year. The hogs have been kept in a corral, where they have plenty of room to exercise, and have done exceptionally well at all times.

IMPROVEMENTS.

About 6 hectares of land have been brought into cultivation and planted in such forage crops as corn, sorghum, and Guinea grass. The permanent improvements contemplated on this farm will be undertaken as soon as the appropriation act has been passed, and will include not only the erection of buildings but also the clearing of land, building of roads, fencing of the entire farm, and other necessary improvements incident to its operation as a first-class stock farm.

TRINIDAD STOCK FARM.

LOCATION.

This new farm was opened during the closing months of the last fiscal year. It is located in what is locally known as the "Little Trinidad Valley," which opens out into the large Trinidad Valley about 6 kilometers north of Baguio.

SOIL.

The small valley contains about 16 hectares of fairly level land, which for the most part consists of a stiff, red clay soil. It has all been under cultivation at one time or another by the Igorots, who used it especially for growing sweet potatoes. The hill land immediately surrounding this valley consists of clay mixed with a great quantity of broken stone of all conceivable sizes, is very rugged, and only accessible by following around the hills in certain directions. The land under the control of this farm is all quite broken, being frequently cut by deep canyons, and is estimated to contain about 400 hectares.

WATER SUPPLY.

The water supply at the buildings comes from a small spring, the water of which is conducted down to the barns through a 1-inch pipe. In the heart of the dry season it barely furnishes enough water for all of the stock on the farm. About a kilometer distant from the buildings, across a rugged backbone of the hills, is a small river in the bottom of a canyon. This river can not be reached at a point immediately opposite the farm by the live stock, but a trail has been graded up the stream to a point where the animals can readily gain access to it. Should the water supply in the small valley fail, it will be necessary to put in either a hydraulic ram or pump in this river and carry the water over the top of the intervening ridge to the barns.

IMPROVEMENTS.

The grazing lands are so mountainous and rough in nature as to necessitate considerable work in the building, widening, and opening of trails and roads in order to afford the stock access to the different parts of the range. Other work on the range consisted in fencing along precipices, the filling up of deep and dangerous holes, the building of five grass sheds for the protection of stock during severe storms, the completion of $2\frac{1}{2}$ miles of wire fencing bordering on one section of the pasture, and of fencing to subdivide the grazing lands in order to protect the range.

The improvements around the main quarters have consisted in the construction of a stallion and breeding corrals, paddocks for brood mares and colts, building a grass wagon shed, laying a pipe line which supplies the stabled stock with spring water, plowing of new lands, leveling of mud fences which were of no practical value to the farm, improving the main wagon road by giving it a top dressing of broken stone, and digging ditches to drain the meadow land.

Considerable labor has been performed on the stallions to keep them in proper condition for breeding. This required daily exercise under the saddle and the most careful and thorough grooming.

The condition of the brood mares and burros was rather poor at the beginning of the fiscal year on account of the poor range where they had been kept, and a great deal of time was required to get them back into good breeding condition.

PASTURES.

While the grazing lands controlled by the stock farm comprise about 400 hectares, fully 25 per cent of this is worthless on account of its being inaccessible to large animals, and the remaining portion is a poor class of pasture land. The range is subdivided into several sections and the cattle have been kept in fair condition by moving them from field to field. During the dry season, when the mountain pasture was exhausted, the cattle were removed to the Trinidad Valley, which is public grazing land. The principal grass in this section is a species of wild rye and grows very slowly, even during the rainy season. After being grazed during the dry months, the grass on the exposed range dries up and is almost worthless as a forage. Investigations last March showed many places on the range to be as clean as if swept by fire. Only in the canyons and gulches can any good grass be found during the dry season, and these places are often dangerous to stock on account of the pitfalls, underbrush, and deep holes. The loss by death of cattle grazing in the canyons last year was very large. The superintendent of the farm estimates that to subsist one cow and calf per year on this range requires about 6 hectares of grazing land. The present size of the herd has taxed the pasture to its full capacity the past year. There is but a small area of grazing land on which imported horses, and mares with colts, can graze with any degree of safety.

STOCK ON HAND.

Stallions, imported, 2; mares, imported, 14; mares, native, 20; colts, yearling male, 1; colts, yearling fillies, 41; colts, suckling, American, 4; colts, suckling, grade, 5; burros, jack, 6, jennets, 11; bulls, imported, 3, grade, 3; cows, imported, 1, native, 47; steers, grade, 6; calves, heifers, grade, 23; bullocks, 17; boars, Berkshire, 1, grade, 2; sows, grade, 1; goats, 4; sheep, 8; making a grand total of 185 domestic animals at the farm.

INCREASE BY BIRTHS.

The increase by births for the past year is as follows: Colts, American bred, 5; colts, grade, 7; calves, grade, 13; steers, grade, 6; sheep, 2; goats, 1.

BREEDING.

The Arabian "Beder" and the Morgan "Duke of Albany" are the two stallions at the head of the stud. Both horses have been in excellent condition to perform the duties required of them. It has been found difficult to induce the Igorots to avail themselves of the opportunity of breeding their mares to these horses. Only by great persuasion were three native Igorot owners of mares induced to breed to "Beder." The

result of the breeding performed this year is as follows: "Beder" served 4 imported mares and 8 native mares, property of the Bureau of Agriculture, 1 American mare belonging to the Army, and 5 other native mares, making a total of 17 mares served. "Duke of Albany" served 11 American mares, property of the Bureau of Agriculture, and 8 American mares belonging to the Army, making a total of 19 mares served. The Galloway bull served 15 cows belonging to private parties, besides running regularly on the range with the Government cattle. The Devon bull was bred to 5 cows belonging to the Bureau of Agriculture. The Berkshire boar served about 30 outside sows. The grade boar served about 25 outside sows.

One grade Galloway bull, 2 years old, is doing service at Mr. Lewis's stock farm near San Fernando, La Union, and one grade Galloway bull, 2 years old, is doing service at a small stock farm in Lepanto-Bontoc. One Australian bull is doing service on another stock farm at Bua, Benguet. The breeding season of the horses commenced on November 1, 1906, and ended July 31, 1907. This period was selected for the following reasons: The mares would have their colts between October 3 and July 2, thereby avoiding foaling during the severe rain storms which annually visit this section of the country during the months of July to October, inclusive; also, the stallions needed a rest of a few months each year to recuperate after a vigorous season of stud service. The cattle, sheep, goats, and hogs have been allowed to breed the entire year. It is the intention for the ensuing year to separate the bulls from the cows, as has been done with the stallions.

CARING FOR STOCK.

The past year's experiences in handling equines have demonstrated that, to successfully raise them here, they should have daily care and attention and should not be required to rustle for themselves. During the rainy season they should have access to proper shelter. The care required consists in a liberal daily ration of hay and grain, stabling and grooming. The imported horses and cattle have not done well on the range. At times during the rainy season (clear weather) they will do a little foraging, but if left to subsist themselves they rapidly fall off in flesh. The native-bred horses and cattle are much better rustlers than the imported stock, and by keeping as close to their natural habits as possible without putting them to severe hardships they will thrive fairly well.

WOOD TICKS.

The ticks have been a great source of annoyance to the horses and cattle, particularly during the dry season. The calves and colts have had to be bathed with dip on an average of every six weeks, and yet ticks could be found on them at all times of the year.

CLIMATE AND HEALTH.

The climate in this vicinity is temperate, mild, and cool for the greater part of the year. During the rainy season the rains are copious and frequent. The climate seems to agree with the health of all domestic animals on the farm, and during the past year the stock has continued to be free from malignant, contagious, or infectious diseases.

MORTALITY—LOSS.

The death records of stock show that 5 cows died from accidents received in pasture, 1 American suckling colt from diarrhea, 1 suckling burro colt from acute peritonitis, 4 adult burros from accidents received in pasture, 2 bullocks from old age, 1 young steer from debility, 1 native mare during period of parturition, 1 colt from accident in pasture, 1 lamb was killed by a dog, 1 pig was drowned, 2 cows could not be accounted for (probably stolen), and 1 carabao was stolen.

FORAGE CROPS.

Experiments in the raising of forage crops have been very limited. The most successful forage plants so far developed are oats and Bermuda grass. Oats sown on well-manured land produced a healthy, quick, luxuriant growth, but failed to produce seed on maturity, the heads of the plants being empty. The green oats if cut and cured make fair hay. Bermuda grass can be found growing in many parts of the Trinidad Valley, and when transplanted does exceedingly well. This grass has a tendency to grow during the dry season when other grasses are apparently dead. Guinea grass raised from transplanted roots sent here from Manila and set out in well-manured, rich soil has done remarkably well and may be a valuable forage plant for this section of the country; the seed of the Guinea grass was planted in several places under several different conditions, but failed to germinate. Volunteer clover when transplanted grows very well in the rainy season, but perished during the dry months. By irrigation, however, clover may be successfully raised.

IMPROVEMENTS CONTEMPLATED.

During the coming year it is planned to erect a separate building to contain sufficient stalls for all the stallions kept at this farm. It has proven quite an unsatisfactory arrangement to keep them in the same barns with the mares and colts. The main hill range lying west of the buildings will have to be fenced to protect it against the invasions of outside stock. It is also planned to fence in a portion of the main Trinidad Valley, now used as public grazing land, and to utilize it both for the grazing of the Government stock during the dry season and as a breeding station for horses and cattle from the surrounding country. Grasses and clover will be put out on the level lands surrounding the buildings and small plats of Bermuda and Guinea grasses will be set

out all over the range to be used in future as a source of supply for the further extension of these grasses. Experiments will also be made on these ranges with imported clovers and grasses such as lespedeza and orchard grass.

RECOMMENDATIONS.

The following recommendations are respectfully submitted with a view to bettering the services rendered by this Bureau:

(1) That the provincial force of employees be increased by the addition of one special agent or superintendent of extension work, whose special duty it shall be to advise the people in the provinces of the work done by this Bureau and secure their coöperation; five veterinarians, desired on account of the increased work in the control of infective animal diseases; three agricultural inspectors; and nine assistant agricultural inspectors with the same qualifications as inspectors. These inspectors and assistant inspectors are desired as general agents of the Bureau in the provinces to supervise the crop-reporting service and investigate all questions relating to agriculture and animal industry.

(2) That there be passed a general veterinary sanitary law[1] for the Philippine Islands under the provisions of which the Bureau of Agriculture can control the movements of live stock and thereby prevent the further introduction of infective animal diseases.

(3) That stock yards with suitable isolation, and with a sufficient capacity to hold all animals imported into these Islands or otherwise brought into or through these ports, be established in the cities of Manila, Iloilo, and Cebu. These stock yards are designed to be used also as quarantine and inoculation stations during the time necessary for the eradication of the fatal infective animal diseases now existing in the Islands. Nothing short of absolute eradication of these diseases will ever restore complete prosperity, and it is recommended that, whatever action be taken, this object be kept in view.

(4) That small inoculation stations be established at Batangas, Province of Batangas; either Bacolod or Silay, in the Province of Occidental Negros; and Legaspi, in the Province of Albay—to be used as quarantine and inoculation stations so long as the necessity for them may exist.

(5) That suitable sites be selected and experiment stations established for work with the standard crops of the Islands, such as abacá, cocoanuts, tobacco, and rice. None of the farms at present operated by this Bureau is located so as to be adapted to all of these crops, which furnish our principal commercial products. If one satisfactory site could be found on which all of them would grow well, it would be just that much better.

[1] On October 10, 1907, Act No. 1760, "An act to prevent the introduction into the Philippine Islands of dangerous communicable animal diseases, to prevent the spread of such diseases within the Islands, and for other purposes," was enacted by the Philippine Commission.

(6) That small temporary stations be established at Sablan and Naguilian on the trail from Baguio to San Fernando, Union, and operated in connection with the Trinidad farm, with a view to testing the growth of different crops at varying altitudes.

(7) That the present sugar farm in Occidental Negros be converted into a general experiment station with a view to working with crops particularly adapted to the Visayan Islands. It is probable that the proposed experimental work with sugar cane, abacá, rice, and cocoanuts can be carried on at this farm, which is also suited to work in animal industry, especially with cattle and hogs.

G. E. NESOM, *Acting Director.*

The SECRETARY OF THE INTERIOR,
Manila, P. I.

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CONTENTS AND ILLUSTRATIONS.

CONTENTS.

ILLUSTRATIONS.

EDITORIAL.

PROPOSED LIVE-STOCK DEPOT.

The most important question under consideration by the Bureau of Agriculture for the coming fiscal year is the establishment of a live-stock depot for the city of Manila. It will not only serve as a storage place for all live stock shipped to Manila but will be used as a quarantine station, in which imported cattle brought from China may pass a period sufficient to determine whether or not they are infected with rinderpest on arrival in these Islands.

It is now undisputed that one of the principal causes of the persistence

of rinderpest in the Philippine Islands is the fact that for many years the disease has been constantly imported and spread throughout the length and breadth of the Archipelago by cattle arriving from Chinese territory.

The principal part of these animals come from the port of Honkong, where the government has an excellent live-stock depot, with all modern facilities for handling cattle from a commercial standpoint. Their provisions and system of management, however, are quite inadequate to guarantee that the animals passing through there will not take with them rinderpest and other diseases which prevail to a greater or less extent throughout China.

A careful record of all shipments received in Manila from June 1 to November 1, 1907, shows that out of one hundred forty-six shipments, containing 15,545 head, one shipment, containing 26 head, was entirely free from rinderpest. Sometimes a shipment of as many as 250 head arrives with only one or two cases of rinderpest on board, but the ship is infected and many cattle subsequently develop the disease.

This is not an unjust criticism of Hongkong, for the simple reason that there are no cattle raised on the Island of Victoria, but all live stock shipped from that port originates in Chinese territory and merely passes through Hongkong. It would be unreasonable to expect that the sanitary system there could be so perfect as to free the cattle from rinderpest or other diseases as they filter through that market.

The fact is, it is fully recognized now that these Islands must look out for their own interests by establishing their own live-stock depots and their own system of veterinary inspection. Hongkong has shown a very friendly interest and hearty spirit of coöperation, which is duly appreciated by this Government, but at the same time they cheerfully admit what we already knew, and that is that a quarantine here is much more effective for our purposes than one in the Hongkong live-stock depot.

About 40,000 head of cattle and carabaos per annum are shipped into Manila and of these approximately 30,000 head come from China and Indo-China.

In this connection it may be of interest to call up a brief history of the Veterinary Quarantine Law (Act No. 1760), which was enacted October 10, 1907. Those who have been in charge of the work in animal industry on behalf of the Government have realized for several years that one of the important features connected with the control of animal diseases was a satisfactory quarantine law.

When the veterinary work was performed by the Board of Health a draft of a law was prepared, but apparently never submitted to the Philippine Commission. When the division of veterinary medicine was transferred to the Bureau of Agriculture, November 1, 1905, the draft

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V1, no 2, 4-12

of this law was sent over with the other office papers. This was rewritten by the Assistant Director of Agriculture and forwarded to the Secretary of the Interior under date of February 28, 1906. After some months' consideration it was approved and sent to the recorder of the Commission to be introduced as a proposed act.

This had not been done up to March 1, 1907, at which time the Assistant Director of Agriculture appeared before the Philippine Commission at Baguio and requested that the proposed act be introduced and read. The Secretary of the Interior was absent in the United States at this time and it was not well received by a majority of the Commissioners present.

It was withdrawn and the matter was allowed to rest until October 1, 1907, when it was again taken up through the Secretary of the Interior, was discussed before the Commission, and enacted on October 10, 1907. Certain features of the act were at once put into effect, but the necessary machinery for enforcing it in its entirety did not exist and does not at this writing.

A live-stock depot to be used largely as a quarantine station will help to solve this question. It will probably be taken up in the near future by both the Assembly and the Commission, and as many members of both bodies have already expressed great interest in the subject, there is little doubt but that favorable action will be taken in providing the necessary funds for the depot.

Smaller stations will be established in Iloilo, Cebu, Zamboanga, and other open ports of the Islands, and some special provision should be made for the small ports through which only interisland cattle trade is carried on.

When once established these depots will be the real beginning of a crusade against a scourge which has held these Islands within its grip for almost twenty years. It may be possible that rinderpest is enzoötic in the Philippine Islands, but the success which has attended the extermination of the disease in Europe and in many provinces of these Islands points clearly to the fact that it is not so, but constantly prevails because of its continual reintroduction.

It is confidently believed that the work can be so successfully performed that the entire population of the Islands can be made to realize that it is possible to completely stamp out rinderpest in the Philippine Islands.

When this realization comes to the people and they make a serious effort to rid themselves of the pest by helping the Government officials in enforcing quarantines, teaching the value of sanitation, and otherwise giving a hearty spirit of coöperation toward that much-desired end, it will be only a short time until the disease will have passed beyond the shores of these Islands.

THE CARNIVAL AND HORSE SHOW.

Before this issue of the REVIEW reaches the public the Carnival and horse show will have passed into history. The Carnival for 1908 was not planned as an agricultural exposition, although there will no doubt be many exhibits of that character shown there. Nor was the horse show intended for exhibiting live stock in general. But in these Islands agriculture is by far the most important industry and all exhibitions which will correctly represent the work done by the mass of the people must include agricultural displays.

The Carnival Association should continue to exist, and the auxiliary organizations such as the horse show should be blended with it and every energy bent toward the common end of having a great industrial exposition, agricultural fair, livestock show, hippodrome, and field meet combined.

In order to be a permanent success the Carnival each year should assume more and more the nature of a State fair, at which everything of interest in the Islands will be exhibited, thereby attracting large numbers of people and making it of interest to all, whether on business or pleasure bent. Induce all of the agricultural, medical, sanitary, industrial, business, and social organizations in the Orient to hold their meetings here at Carnival time. All roads in the Orient lead to Manila, the most cosmopolitan city in the Far East.

Great credit is due to the promoters of the Carnival and horse show, and future success can undoubtedly be assured if the features are made of such varied nature that there will be no man, woman, or child in the Philippine Islands or the whole Orient who will not be interested in something which is going on in Manila at that time.

THE FORAGE PROBLEM.

Our leading article this month is on the subject of forage, with special reference to the Philippines.

The United States Army here is the largest consumer of forage, which consists principally of oats and timothy hay, generally imported under quartermaster contract.

The value of the forage imported into the Philippines is approximately ₱2,000,000, of which the Army consumes more than ₱1,000,000 in value, the Civil Government ₱600,000, and private parties the remainder. The cost delivered in Manila to the Army is 3.88 centavos per pound for oats and 2.50 centavos per pound for hay. The Bureau of Supply is paying 4.51 centavos per pound for oats and 4.28 for hay.

The trade is principally with the United States, although there is a liberal amount of all classes of forage brought here from Australia and India.

The Bureau of Agriculture has undertaken to bring out some facts of interest on this subject, a few of which are recorded in this article. The notes which enter into it have been prepared from accumulated materials covering a period of several years.

A glance at the composition of Australian and Indian "crushed feeds" is sufficient to show that they are made for the most part from materials which can be produced in the Philippine Islands. The principal ingredient is corn, the second is beans. Corn predominates in the Australian feed and beans in the Indian. Why should we continue to purchase these feeds abroad when corn and a great variety of beans can be produced in unlimited amounts in the Philippines and sold at from 1 to 3 centavos per pound? It is true we do not grow to any extent the "gram" which is principally used in the Indian crushed feed, but we have an abundance of better beans, such as mango, patani, and cigarrillo.

Practically all of the hay used here is shipped from the United States, although a small amount, especially alfalfa, is received at irregular intervals from Australia. The so-called "compressed fodders," which are represented to be oat or wheat hay, are in most cases nothing but the straw and chaff of these two grains; hence they are only a little better than rice straw, of which we have immense quantities burned in the fields every year.

There is no trouble in producing here a much better hay than is represented by this type. A hay that will be a very satisfactory substitute for timothy, both with reference to chemical and physical qualities, can be produced here from such materials as guinea grass, teosinte, corn, and sorghum, but, on account of the coarse nature of these materials and the difficulty of curing fodder in the Tropics, they will all probably have to be cut, shredded, and crushed to a degree of fineness which will make it easy to dry them out by artificial heat. Then by packing the fodder into bales while dry it will, no doubt, have such keeping qualities as to warrant its shipment to any part of the Islands, where it can be stored as long as may be required.

There are people who will stand ready to say that such feeds will not be satisfactory, especially for the Army. There are, no doubt, many Army officers who will say on first thought that oats and timothy hay are good enough for any Army horse. It will, therefore, be necessary to get an attitude of tolerance for some substitute for the oat-and-hay ration before native-grown feeds can be used to the exclusion of those now imported. Then there will be such arguments as we often hear expressed in the homeland regarding the bad qualities possessed by these substitute foods. One of these is that corn is too heating to be fed in a hot country. Another is that if any sorgrum enters into the fodder it will probably cause bloating and lead to serious losses by virtue of flatulent colic. Such statements are not made advisedly, and it may be well for

those persons who oppose the use of corn in the Philippines to know that the forage on which the mules and horses of the Southern States are fed consists largely of corn and corn fodder. In the same way sorghum is being used by thousands of farmers all over the world, with no bad results whatever.

The two great considerations to be looked forward to are to prove beyond the shadow of a doubt that satisfactory substitutes, in the way of grain and hay to replace oats and timothy hay, may be produced on a commercial scale and sold cheaper than the imported forage now being used; to overcome the objections which American officials in the Philippines, whether in the Army or the Civil Government, may have to substituting for oats and hay the so-called "crushed feeds" and "compressed fodder," which form the substitutes will no doubt assume.

It is a project well worth considering, as it will mean more than ₱2,000,000 of business annually to the people of the Philippines to which they are entitled, and will mean a saving to both the military and civil branches of the Government.

FORAGE INVESTIGATIONS IN THE PHILIPPINE ISLANDS.[1]

INTRODUCTION.

The local production of an abundant supply of satisfactory forage for domestic animals is a question of great economic importance in the Philippine Islands. During the entire period of American occupation of the Islands, the purchase of imported forage for feeding live stock has constituted a large item of expense both for the military and the Civil Government.

The forage question in the Philippines presents two quite different aspects, namely, the production of a supply of forage for what may be termed our "local" live stock, such as carabaos, Philippine ponies and cattle, and the production of forage that is suitable for feeding imported live stock, including horses, mules, and cattle received principally from the United States and Australia.

The first of these two propositions is a comparatively simple one, as our local live stock is fed almost entirely on green forage, rice straw, rice polish, and other products of minor importance, all of which are produced in abundance and without difficulty in this country. The feeding of imported horses, mules, and cattle that have been accustomed to receiving a daily ration of hay and grain is, however, quite a different matter, and, up to the present time, this class of live stock has been largely subsisted on imported forage.

The question of producing locally a supply of forage suitable for feeding our imported live stock, and that of increasing the supply and improving the quality of the forage grown for our local live stock, have received a considerable amount of attention. Numerous field experiments have been carried on in growing both imported and local forage plants. This field work has been supplemented by laboratory research and by investigations as to the forage supply in other countries of the East, where conditions are more or less similar to those found in the Philippine Islands.

FORAGE SUPPLY OF MANILA.

In 1903 the botanist of the Bureau of Agriculture, in a report on the "Forage supply of Manila," stated in part as follows:

From preliminary observations on this subject it appears to me doubtful if hope can be entertained of improving the present supply of

[1] Compiled from special report prepared by the Director of Agriculture for the Secretary of War.

forage, the present supply being on the whole superior, both in quantity and quality, to that of most other cities of like size in the East.

The present sources of supply can be classed as domestic and foreign, the former to include the various species of grasses utilized uncured, and unhulled rice (palay); the latter to include all grains, hay, etc., imported from America, Australia, and Asia.

Like other cities in the East, the chief forage for cattle and horses in Manila is grass, which is cut fresh each day and sold by various local dealers to supply the daily needs of the city. Nowhere in the Philippines is any attempt made to produce hay; yet it seems possible that hay farms in the vicinity of Manila would be both successful and profitable. Cured hay could not be kept long in the stack, as it would soon mold, and to prevent this it would of necessity have to be baled soon after curing.

The chief source of the forage supply of Manila is the grass commonly called "zacate" (*Homalocenchrus hexandrus* (L) O. Kuntze), which is extensively cultivated in the vicinity of the city, large areas having been adapted to the cultivation of this grass. It is grown in shallow water, in paddies very similar to those prepared for rice culture. The origin of the method of cultivating this grass is obscure, but it has probably been developed in Manila to meet the conditions existing here. The grass is a native of the Archipelago and is also found in tropical and subtropical regions throughout the world.

In discussing the grasses utilized in Manila, but one species, *Homalocenchrus hexandrus*, need be considered, although to a very small extent Bermuda grass (*Cynodon dactylon*) is used, and also one or two other species. In the provinces, Bermuda grass is the most extensively used for forage, although in some sections sorghum, Indian corn, etc., are utilized, and rice straw is used to a limited extent.

FORAGE PLANTS AND MATERIALS INVESTIGATED BY THE BUREAU OF AGRICULTURE.

The large number of different forage plants and materials that have been investigated by the Bureau of Agriculture may be roughly divided, according to the results obtained, into the two classes, "Successful" and "Results pending." These investigations, briefly stated, have been as follows:

SUCCESSFUL.

1. *Corn, native.*—The type of corn commonly grown in the Philippine Islands is a small yellow flint kind with large cob and shallow grain. It is planted on hillsides at the close of the rainy season in the eastern portion of the Islands, but is also planted to some extent at the beginning of the rainy season for harvest during the short dry spell which sometimes occurs in August in certain sections, such as Laguna Province.

This corn has been grown by the Bureau of Agriculture a number of times, but the yield is found to be small and uncertain. It does not withstand heavy rains and dwarfs badly in dry weather. The production

is better on black sugar lands than on sandy soils, but it produces a much more satisfactory crop when grown in the dry season with irrigation. This corn is commonly harvested without removing the husks, which are often turned back over the base of the ear and used for braiding the corn into strings like garlic. It is put up in bunches intended to be sold for a definite price. The common size of a bunch is twelve ears, which sells for 20 centavos. There is no commercial supply of this corn available as a general rule, although some of the distillery companies in Manila have sent out buyers who have succeeded in collecting large stores of it to be used in the manufacture of alcholic liquors, particularly in Laguna Province, which reveals the fact that the corn can be purchased at about ₱3.50 per cavan of shelled corn. A cavan of shelled native corn weighs approximately 119 pounds, which would make the price per pound 2.93 centavos.

One difficulty about corn growing in the Philippines is saving seed from one dry season to another. The hard flint varieties prepared by husking, as above described, and hung suspended in the house where there is some heat every day, keep fairly well. This probably accounts for the growing of this type of corn to the exclusion of the white dent varieties.

Native corn has been successfully grown at all of the low-country stations of this Bureau, especially at Manila, Batangas, and La Carlota, but does not thrive well at La Trinidad station, Baguio.

Poor success has been obtained in curing the stover, as the residual moisture is high and the fodder tends to mildew. If grown for grain alone and the ears ground on a corn-and-cob mill it should prove a grain feed of great value in these Islands.

2. *Rice.*—This tropical grain is grown extensively all over the Philippines. There are probably produced here more than fifty varieties, varying from the small flinty red kinds to the large, globular, white, soft types. It is the standard farinaceous diet of the people and is, no doubt, used more extensively for stock feeding than any other grain produced here. Fed as palay or paddy, it is not relished by American horses, which are accustomed to oats, probably on account of the rough spinous structure of hull. The native ponies, carabaos, and cattle eat it readily. It produces a heavy yield of green forage, which is of poor quality on account of the spines on the leaves. The hulls have no feeding value, but the polish or rice skin, which is rubbed off of the grain in milling, is sold in the markets under the name of "tiquitiqui" (rice polish) and constitutes a staple stock feed, especially in Manila.

Binlid (broken rice) and other low-grade forms of rice are sometimes sold for stock feed. The Bureau of Agriculture has grown probably twenty different varieties of rice, most prominent among which have been dinalaga, which is an irrigated smooth variety, produced extensively in Tarlac Province; Ilocano bearded, a large cylindrical rice, but with

very long beard, common to the west coast of northern Luzon; Carolina golden, a smooth American variety imported from Georgetown, South Carolina; and a number of mountain varieties, especially those from the Province of Nueva Vizcaya.

In addition to the uses above mentioned, rice, on account of the ease with which it can be grown almost anywhere in these Islands, promises to be of some value when cut green and cured as a fodder for use in a compound food. At the present price of cleaned rice it does not seem probable that the grain, which is salable for human food, could be incorporated economically in a compounded stock food.

3. *Kaffir corn.*—This nonsaccharine sorghum has been successfully grown at all of the low-country stations, but has failed at La Trinidad station, Baguio. It is very resistant to drought, produces a heavy green forage and an abundance of seed, which are comparable with corn in food value. All animals eat it readily when green, but it is too coarse and heavy when dried, which is a very difficult process. Excellent results have been obtained when planted with velvet beans, the vines of which run up the stalks of Kaffir corn, and the two are cut together for use as green forage. This is considered the standard forage plant grown during the dry season at Singalong.

4. *Other sorghums.*—A number of other varieties of sorghum of the sweet and nonsaccharine kinds have been grown. The early amber and orange varieties are almost as good as Kaffir corn, but are probably more dangerous as a green fodder on account of their tendency to produce bloating. They are not so resistant to drought and produce a smaller yield of seed.

Two native varieties, procured from Negros, produced a small growth of stalk, but an abundance of seed, all quite coarse and of poor feeding quality.

Illinois broom corn grows well in the rice lands surrounding Manila, both during the rainy and dry season. It is coarse and fibrous and of poor feeding value.

5. *Teosinte.*—This forage plant received a great deal of attention shortly after this Bureau was organized, but it did not give as satisfactory results as were at first anticipated. Teosinte can, however, be successfully grown here and it makes an excellent forage, although it is not so desirable as Kaffir corn. It is very succulent, giving apparently a heavy yield, but the amount of dry matter produced is not in excess of that produced by other good forage crops. It does not withstand drought as well as any of the sorghums, produces seed of good quality rather sparingly, and the seed deteriorates during the rainy season. When cut and cured as stover, it has the advantage over the sorghums of having a finer stalk and leaf and curing out more like corn. It would, no doubt, be a very valuable ingredient in a compound food. It produces better in these Islands at sea level than at higher altitudes.

PLATE I. A FIELD OF TEOSINTE.

6. *Bermuda.*—This "blue grass" of the Southern States may be regarded as a native of these Islands. It has, no doubt, been here for many decades, is of universal habits, growing quite well in all the islands from sea level to mountain top. It is abundant near Manila, around Laguna de Bay, where it is inundated with several feet of water for several months in the year; in the Candaba Swamp, where it occupies all of the lowlands on which the overflow kills off the coarse grasses like talahib, and is about the only grass that survives the dry season about Baguio. It is the one native grass which promises well for the production of hay, as well as being the standard pasture grass for all classes of lands. It takes the place in Manila of all the lawn and carpet grasses, in producing the beautiful sods which may be seen in the botanic gardens and parks. It withstands drought remarkably well, and while it does not grow under shade in the Southern States, it forms a good sod under trees in the Philippines.

7. *Zacate.*—This is a general term applied to any kind of green forage produced in these Islands. The grass usually sold under the name of "zacate" is grown on flooded lands under conditions similar to those for growing rice. This grass is cut by hand with knives, and bound in small bundles weighing from 8 to 12 ounces. The zacate so commonly sold on the market in Manila consists principally of the grass known by the native name "barrit." Another coarser species, grown also on flooded lands and of a very succulent nature, is known as "malili" and is used principally for feeding cattle and carabaos. The native leguminous plant known as "manimaniang" (little peanut) is harvested to a limited extent and sold as zacate.

During the rainy season the native crab grass which springs up on all unoccupied lands is extensively cut as green forage.

The zacate purchased by the Army at about 65 centavos per hundred pounds consists largely of barrit. On a basis of dry imported hay, it is not worth, as a forage, more than about half this price.

8. *Guinea grass.*—A few roots of this grass were received last year from the Hawaii experiment station, Honolulu. They have been successfully grown and reproduced both by division and from seed. We now have more than an acre of this grass growing at the Singalong experiment station and, for the production of green forage, it is the most promising tropical grass ever seen in these Islands. On account of its coarse nature, it does not cure readily, but can probably be cured sufficiently in the dry season for storage. While only small plats have been available for yield tests, the indications are that the grass will give from 5 to 15 tons per acre per cutting and that it may be cut every eight to twelve weeks, varying with the soil, season, rainfall, irrigation, etc. It is reputed to withstand drought very well, although the small area we had last dry season was thoroughly irrigated in order to keep it growing vigorously in order that it might be propagated rapidly. It is now being sent freely

to stations of this Bureau at Baguio and La Carlota, to Army posts, and to officials and private parties throughout the Islands.

9. *Paspalum dilatatum.*—This is a species of what are commonly known as the water grasses in the Southern States, though it comes from South America and is said to be very resistant to drought. It was only introduced here a year ago and it has not made such a vigorous growth as the guinea grass. The stems are recumbent and it could not be successfully harvested as green forage or hay unless a taller growth could be induced. It will, no doubt, prove a valuable pasture grass and may be more resistant to the inroads of cogon and talahib than is Bermuda.

10. *Italian rye grass.*—A small plat of this grass was grown at the Trinidad station at Baguio and is reported by the superintendent as quite successful. It has not yet been produced on a large scale, but will probably prove to be a valuable forage crop in the mountainous regions.

11. *Velvet beans.*—The Florida velvet bean was introduced by this Bureau as a soil renovator especially to follow rice, and incidentally as a forage plant. It has proven rather disappointing in the rapidity and vigor with which it has grown.

A native species of velvet bean (*Mucuna lyonii*) has been brought into cultivation by this Bureau and promises to prove a much more vigorous and satisfactory forage bean than the Florida variety. It produces an abundance of seed in large racemes which are easily harvested.

12. *Field peas.*—The native varieties commonly sold in the market as human food have been quite successfully produced. A prominent long-podded variety, known as "sitao," grows well in Laguna Province. Both the beans and vines are relished by live stock and it is considered a very satisfactory adjunct to leguminous forage crops. The American varieties known as the "whip-poor-will" and "clay peas" have been imported and planted, frequently with rather poor success. They do not withstand the rainy season like native varieties and are badly attacked by insects during the dry season. One of the most promising imported varieties is now being grown at the Singalong experiment station under the name of "Venezuela black bean." Both the velvet beans and field peas seem to thrive better at the lowland stations that at Baguio.

13. *Beggar weed.*—This plant, which is grown in Florida as a forage crop, was introduced and successfully grown at Batangas experiment station in 1904–5. It did not promise to prove popular as a forage plant, and, as it might have become a pest, its further cultivation was abandoned.

14. *Sweet potatoes.*—These grow in great abundance all over the Islands and constitute a staple article of diet for the people. They have been tried in a small way as a root-crop food for live stock, especially hogs, and are about as valuable here as in the Southern States. They would, no doubt, have to be pastured, harvested, and fed as fresh roots, or granulated and dried by artificial heat as a component part of compound foods.

15. *Casava.*—This starch-producing root crop may often be seen growing by the roadside in different parts of the Islands. It is not at present used to any extent, either for the manufacture of starch and tapioca or as a stock food. It will, no doubt, prove a very valuable crop for both purposes and should be fed to animals according to the same methods recommended for sweet potatoes.

16. *Chufa.*—This grass grows very vigorously in the Islands and produces an abundance of nuts. It will probably be useful, however, only as a pasture plant for hogs.

17. *Copra cake.*—This by-product of the cocoanut-oil mills is a valuable stock food, but it has the objectionable quality of becoming rancid. Ordinary milling processes leave 10 or 20 per cent of oil in the cake. This oil decomposes in a few weeks and produces that disagreeable stench characteristic of cocoanut oil. If the oil remaining in the cake after it leaves the presses were extracted by petrolic ether, or other processes similar to those used in Louisiana and Texas for extracting the oil from rice polish, it would greatly enhance the value of copra cake as a food product. As sold in Manila it is not greatly relished by horses or cattle and is rather unpopular as a food stuff.

18. *Distillery slops.*—This well-known feeding stuff, so commonly used in the United States both as fresh slops and dried brewer's grain, is available to a limited extent in Manila, both at the San Miguel Brewery and at the whisky distilleries. It always finds ready sale, especially for feeding hogs and carabaos, and at prices which would prohibit its use as a component in a mixed feed.

RESULTS PENDING.

1. *Corn, American.*—Both white and yellow dent and flint varieties have been introduced a number of times. At the Batangas station a southern-grown white dent variety gave a good yield. At Singalong good but less satisfactory crops have been produced due to poor soil. Good reports have come from outside growers, but a general failure to carry seed over through the rainy season has discouraged the growing of these corns. The dent varieties are the most prolific, but the physical structure of the seed is such as to cause it to harbor moisture and to lose vitality during the rainy season. Even with careful selection we have failed to secure ears quite up to the type of the imported strains. At high altitudes (La Trinidad, Baguio) they have not been successful. American white dent corn as roasting ears is in great demand in Manila. To save seed a process devised by this Bureau of packing the corn in vessels with powdered charcoal, heating gently, and sealing hermetically is recommended.

2. *Wheat.*—Five varieties of this grain, especially selected by the United States Department of Agriculture as varieties best suited to tropical conditions, were tested during the past season at La Trinidad

experiment station, Baguio. All the varieties grew to fair size, but rusted badly and produced only a small amount of grain.

3. *Oats.*—The winter and Texas rust-proof varieties have been grown for two years at La Trinidad where the panicles failed to fill, but a fair stand of forage was obtained from three consecutive plantings. As a dry or green forage plant for the northern mountain region, oats seem to promise some degree of success. At the Singalong station oats were grown for only one year and the crop succumbed to the adverse conditions when half grown. The necessity of depending upon outside sources for a seed supply, and the fact that grain is not produced, will discourage the commercial growing of oat hay.

4. *Barley.*—At the Trinidad station barley gave results similar to those obtained with oats—a good stand of straw and an entire failure of the grain. The inducements for its continued planting are less than for oats.

5. *Millet.*—At the Singalong experiment station Italian and Japanese millets were grown for both straw and grain. No outside distributions were made. When planted in January and April at La Carlota they gave good results.

6. *Soy beans.*—These have been imported from both the United States and Japan. Our own trials at Singalong and at Batangas gave returns of seed and forage that were not satisfactory. From outside distribution we have had no reports.

7. *Alfalfa.*—Tests extending over four years have been made with this useful legume. Reports from about a score of outside sources, indicating quick germination and a "good stand," have been received. Later reports, without exception, tell that the "good stand" quickly "died off." Such was the experience of this Bureau in Batangas, where large plantings (10 or more acres each year) were made on unirrigated lands. At Singalong like results were had until in 1906, when the specific alfalfa nitrogen bacterium was obtained from Washington, and a plat sown with inoculated seed. Establishment was very slow, owing to the nearness of the water table to the surface, but as the dry season advanced growth became more rapid and strong. Two cuttings were taken, but when the following rainy season set in the entire plat died out. Alfalfa, generally promising for a short time, has always failed, not only in Manila but everywhere in the Islands except Trinidad, and there it is still doubtful. Small plats on top of ridges were successfully carried through the past rainy season, and look promising. It is deemed very desirable to experiment further with alfalfa, especially in the inoculation of the soil.

8. *Clovers.*—Red clover was grown for a few months at Singalong during the season of 1905 upon uninoculated land, and a half crop was made. It stood fairly well till the dry, hot season was well advanced. Dutch clover, tried at La Trinidad, was unsatisfactory. Japanese clover, tried at Singalong and Batangas, failed to grow.

9. *Miscellaneous legumes.*—Sanfoin does not grow as fast as clover or vetch. It needs, nevertheless, another year's trial before deciding on its merits as forage.

Berseen grows slowly, and, although sown on a soil well fertilized, failed to give a second crop. Does not set seed.

Sulla, tried at Singalong and other places, gave unsatisfactory growth; in Batangas Province it made a fair start, but proved short lived.

Vetch, the variety *V. villosa,* grows rapidly, is tall and leafy, but does not set seeds. The variety *V. sativa,* although not so tall and rich as the other kinds, bears seed plentifully, is very hardy, and is to be recommended.

10. *Artichoke.*—Jerusalem variety procured in Shanghai, planted in October, 1904, made only dwarfed growth and gave a poor yield of small tubers, which latter decayed rapidly when removed from the ground.

IMPORTED FORAGE.

A number of different crushed and compressed fodders are used in large quantities in Manila, and to some extent in the provinces. These fodders are imported from the United States, Australia, and India, and are fed both to imported live stock and (principally in Manila) to native ponies. During the month of October, 1907, a number of samples of the different kinds of imported forage used in Manila were collected and examined by the Bureau of Agriculture. The content, and the local prices at that time, of these materials were as follows:

Australian compressed fodder.—Supposed to contain chopped straw, oats, and bran. Samples examined contained chopped straw, oats, and bran. Price, ₱2.30 per bale of 90 pounds.

Australian compressed fodder (Darling brand).—A bale weighing 110 pounds is said to contain 28 pounds of oats, 6 pounds of bran, and the balance wheat chaff. Sample examined contained oats, bran, and chopped straw. Price, ₱4 per bale of 110 pounds.

V. B. crushed food.—Supposed to contain peas, oats, barley, bran, and corn. Sample examined contained peas, oats, barley, bran, and corn. Price, $4\frac{1}{2}$ centavos per pound.

Indian crushed food.—Supposed to contain peas, barley, oats, and bran. Samples examined contained peas, barley, oats, and other seeds. Price, ₱6 per sack of 150 pounds.

American chop.—Supposed to contain oats, hay, corn, bran, and middlings. Samples examined contained oats, hay, corn, bran, middlings, and barley. Price, ₱3.50 per sack of 65 to 70 pounds.

Timothy hay.—Price, ₱6 per bale of 150 pounds.

Alfalfa hay.—Price, 5 centavos per pound.

Oats.—Price, $5\frac{1}{2}$ centavos per pound.

Wheat bran.—Price, $3\frac{1}{2}$ centavos per pound.

Oil meal.—Price, 15 centavos per pounds.

FORAGE SUPPLY IN HONGKONG, SINGAPORE, JAVA, AND INDIA.

In the various cities in the East the conditions regarding the forage supply are, on the whole, very similar to those existing in Manila. Little or no hay is produced, but that used is imported from more temperate countries. The chief forage used for native cattle and horses is various species of grasses, either wild or cultivated, and which are fed green.

At Hongkong much forage is imported, the only species cultivated there for forage purposes being guinea grass, which is utilized in a green state. Various species of wild grasses are also used.

In Singapore reliance is placed almost entirely on wild-growing grasses for the forage supply of the city, little or no attempt being made to cultivate forage grasses.

In Java, at Batavia and Buitenzorg, *Cynodon dactylon* is apparently the most extensively used forage grass, although other species are utilized more or less. So far as observed, no attempt is made at either place to cultivate any forage crops, dependence being placed on the wild-growing species.

In the neighborhood of Calcutta no systematic cultivation of forage plants takes place. Lucerne, teosinte, guinea grass, etc., are occasionally cultivated, but for ordinary purposes, and even to meet the wants of the cavalry garrison, it is found that the supply of forage provided by the wild grasses growing in the vicinity of the city is ample, and the conditions of Calcutta may be said in reality to be exactly those of Singapore.

In Madras conditions are practically the same as in Calcutta, the cultivation of grasses being mainly confined to the inclosures around the houses of Europeans. The sewage farms near Madras grow grasses systematically, but they only find a sale for the forage during the hot season, when wild forage is somewhat scarce. At other times they have to make all the grass they grow into hay, which is mainly taken up by the government commissariat department, but is not used by the general public.

In Rangoon the conditions are exactly the same as at Singapore. No grasses are cultivated by anyone, but wild species are collected for use in the fresh state and are, to some extent, made into hay.

At Allahabad, Agra, Lucknow, Cawnpur, and Saharanpur dependence is placed entirely on wild species. Even in places like the large remount depot at Saharanpur, where large quantities of grass and hay are required, the local supply of wild grasses is found sufficient, and in places like Allahabad, Lucknow, and Cawnpur, where there are government grass farms, the grasses there grown are entirely native species. On the damp ground one finds patches of *Imperata cylindrica*, but on the dry ground the prevailing grass is Bermuda, associated with four or five species of *Andropogon*. In not a few parts of the drier portions of upper India the common sorghum (*Andropogon sorghum*), which is largely grown for its grain, is also cut green as a cattle food.

In the vicinity of Lahore, and near other cities in the Punjab, where the conditions of the upper Gangetic plain are intensified, wheat, barley, and oats are all grown as forage plants for horses (cut green), as well as for their grain. (The above notes on the forage supply of *India* are from report of Dr. D. Prain, director of the Royal Botanic Gardens at Calcutta.)

Composition of forage.

GREEN FORAGE.

Name.	Source.	Condition.	Water.	Ash.	Proteids.	Carbohydrates.	Fat.	Fiber.
Timothy	Agricutural Chemistry Ingle.		61.6	2.1.	3.1	20.2	1.2	11.8
Green oats	Agriculural chemistry.	Pending	62.2.	2.5	3.4	19.3	1.4	11.2
Zacate (barrit)	Bureau of Science	Successful	68.84	6.64	2.76	11.88	1.51	8.37
Zacate (balili)	do	do	82.56	2.19	2.96	6.71	.90	4.68
Zacate (manimanihan).	do	do	67.39	3.69	4.28	7.86	8.09	8.69
Bermuda	do	do	73.82	4.02	1.93	12.86	.66	6.71
Teosinte	do	do	87.80	1.20	1.40	6	.10	3.50
Alfalfa	do	Pending	79.70	1.10	2.70	4.10	.30	2.10
Milo maize[a]	do	do	57.74		10.55	69.44	3.21	16.54
Sweet sorghum[a]	do	Successful	66.84		7.70	72.19	3.12	16.81
Kaffir corn[a]	do	do	63.64		9.91	68.94	3.28	17.77
Pop corn	do	Pending	66.21	1.33	2.22	21.73	1.42	7.10

[a] The percentages of proteids, carbohydrates, fat, and fiber are of the total *dry matter.*

HAY.

Name.	Source.	Condition.	Water.	Ash.	Proteids.	Carbohydrates.	Fat.	Fiber.
Timothy	Agricultural Chemistry Ingle.		13.2	4.4	5.9	45	2.5	29
Teosinte	Bureau of Science	Successful	9.4	8.9	10.7	44.5	.8	25.7
Alfalfa	do	Pending	16.1	9.1	22.1	32.9	2.5	17.3
Velvet bean hay	do	Successful	8.4	7.9	15.4	36.3	2.5	21.5
Hay from Murcia	do	do	16.2	7.5	2.4	38.9	.9	34.2
Rice straw	do	do	9.6	4.2	3.4	43.4	1.3	38.1
Italian rye grass	Agricultural chemistry.	Pending	8.5	6.9	7.5	45	1.7	30.5
Vetch	do	do	11.3	7.9	17	36.1	2.3	25.4

GRAINS AND CONCENTRATED FOODS.

Name.	Source.	Condition.	Water.	Ash.	Proteids.	Carbohydrates.	Fat.	Fiber.
Oats	Agricultural Chemistry Ingle.	Pending	11	3	11.8	59.7	5	9.5
Corn	do	do	10.9	1.5	10.5	69.6	5.4	2.1
Copra cake	Bureau of Science	Successful	14.26	5.19	16.85	33.85	10.13	19.67
Rough rice	do	do	12.8	4.7	7	67.1	2.2	6.2
Rice, bran, Saigon paddy.	do	do	11.3	14.7	9	38.7	5.8	20.5
Rice feed, Saigon paddy.	do	do	10.2	19.6	10.6	38.6	8.9	12.1
Rice feed, Philippine Islands paddy.	do	do	12.9	7.5	11.5	54.3	9.5	4.3
Do	do	do	14.7	8.7	13.9	49.3	9.4	4

COMPOUNDED FOODS.

Name.	Source.	Condition.	Water.	Ash.	Proteids.	Carbohydrates.	Fat.	Fiber.
Calcutta crushed food	Bureau of Science		13.6	3.8	12.7	48.2	8.3	13.4
V. B. crushed food	do		11.78	2.86	12.54	62.32	3.9	6.6
Italian fodder cake	do		9.80	10.28	11.87	40.05	1.76	24.25
American chopped feed.	do		11.21	4.05	8.97	63.70	2.37	9.70
Australian compressed fodder.	do		14.10	5.20	6.20	22.30	2.20	26.80
Feed stuff	do		10	16.2	5.20	34.60	4.90	29.10

CONCLUSIONS.

Oats and timothy hay are not grown commercially in tropical countries.

It does not appear to be practicable to grow on an extensive scale in the Philippine Islands any of the forage crops most in favor in the United States.

The types of plants which produce the best classes of forage in the temperate regions are represented in the Tropics by such coarse grasses as Bermuda, guinea grass, cogon, talahib, and bamboo. Other things being equal, the yields of the small grains commonly used in feeding domestic animals decrease as the equator is approached. Rice and corn are the only two important grains which seem to give satisfactory yields in tropical countries.

The production of a commercial supply of forage in the Philippines depends on the extent to which corn, beans, rice products, etc., can be substituted for oats and the better classes of green forage, such as guinea grass, for the hay now used; or the practicability of manufacturing a satisfactory mixed or "crushed" grain feed and a compound hay or fodder made from the products grown here and cured by artificial heat.

These questions are now being investigated and the results obtained indicate that a considerable part, if not all, of the forage required for feeding both our local and imported live stock can be produced in the Islands.

AGRICULTURAL PROGRESS IN PORTO RICO.

Agricultural conditions in Porto Rico are, in many respects, similar to those of the Philippine Islands. For this reason the results of agricultural work in Porto Rico offer many valuable suggestions to the Philippine planter. The following notes are taken from the annual report of the Porto Rico Agricultural Experiment Station for 1906.

INTRODUCTION.

The progress of agriculture in Porto Rico has been decidedly marked during the past year. This progress has been largely influenced by three different factors. First, the improvement in agricultural practice made by the native planters. The more progressive planters are studying their soils, their crops, the scientific progress of their business, and the work of the experiment stations. Second, the influx of planters from the United States. These men come to the island for the purpose of making it their home, and their operations redound to the permanent prosperity of the island by reason of the fact that they improve their lands and greatly increase their productive capacity, and at the same time the profits arising from their efforts are reinvested here. Third, the larger corporations that are locating here for the development of tropical industries. The first of these corporations were interested in the production of sugar; their operations are evident in the great change that has come over this industry since the American occupation.

SUGAR.

The central-factory system has supplanted the small mills with their open kettles and low extraction. These large "centrals" consume the cane grown in distances of 40 to 50 miles, and their operation has resulted in the abandonment of many small mills that now stand idle in the fields. The large centrals purchase the greater amount of their cane from the planters, or else manufacture the sugar on a percentage basis. The small growers find it more profitable to dispose of their cane in this way than to grind it in their small mills of low capacity. In addition to grinding cane of others, the large centrals are growing more or less cane, for the larger part on leased land. Such plantings are usually carried out under the best conditions, taking advantage of the more

modern aids of science. This has a good effect upon the various communities in which such plantings are made by reason of the fact that many planters in the neighborhood watch the results and take advantage of the improved methods demonstrated. The experiment station is planting some improved canes of the island and has also introduced the most promising canes of the British department of agriculture at Barbados. It is estimated by the British department that the yields from these improved canes have increased the output of sugar on the same area about 25 per cent; doubtless an equal increase can be obtained by planting improved canes in Porto Rico.

TOBACCO.

The one crop that has made the greatest advances during the year under consideration is tobacco. There has been a decided improvement in the quality as well as the quantity of this product. The improvement of the quality of the Porto Rican leaf has called the attention of capitalists to the possibilities of this crop in the island. Corporations backed by capital have come in for the purpose of not only growing tobaccos but of manufacturing them, taking advantage of the plentiful supply of cheap labor abounding here. Many acres, especially in the valleys of the interior, have been put under cultivation and prices of lands adapted to tobacco growing have increased enormously. Large factories have been erected in San Juan, Bayamon, and Caguas, employing hundreds of people. These large companies are not only planting tobaccos but are buying much more from the small cultivators. A growing practice is for the handlers to buy the crop in the field from the smaller growers, curing and fermenting the plants themselves under the best scientific methods.

RICE.

The largest importation of food stuff in Porto Rico still consists of rice, which comes from the port of New Orleans. There is some extension of rice growing in the island upon the higher lands; practically no irrigated rice is produced. Many more acres of low ground are being put under irrigation every year and devoted to cane growing. When it is necessary to rotate this ground, or when there is a decrease in the present price of sugar, these lands will probably be devoted to growing rice, for which they are well adapted. From experiments made at the station with a number of varieties, it was found that lowland rices flourish in Porto Rico. When certain economic forces work around, Porto Rico will probably be an exporter of this staple. Although labor is plentiful and cheap, profitable rice growing must be carried out largely with the use of machinery, following the methods obtaining in Louisiana and Texas.

FORAGE CROPS.

The principal forage crops of Porto Rico are malojillo and guinea grasses. These are very rank growing and nutritious grasses, the former growing on the lowlands and the latter on the foothills and even on the mountain sides. It does not seem probable that grasses superior to these two for forage purposes can be introduced. Some experiments have been made in testing lawn grasses, of which Bermuda and grama have succeeded. Bluegrass thrives vigorously for a time, but soon dies out. A number of leguminous forage crops have been under trial as producers of forage and also for restoring nitrogen in the soil. Among these the cowpea is the more promising, making a very rapid growth and producing large amounts of forage. Moreover, this is a plant that not only adds nitrogen to the soil but very greatly improves the physical condition. No serious insect or fungus pests have developed, and this crop is recommended for extended plantings over the island. The shelled bean may be prepared in a number of ways, and is a very nutritious article of human food. The laborers at the station are growing cowpeas in place of their native bean because of the fact that the yields are much larger in amount of food. Other leguminous crops that have given satisfactory results are Florida beggarweed, velvet beans, and pigeon peas.

FIBER PLANTS.

Of the various fibers, sisal promises by far the greater returns under Porto Rican conditions. In coöperation with the Insular Government several thousand plants have been imported and planted. Funds are available under an Insular appropriation for securing a much larger supply, and 100,000 more have just been imported. It is hoped to secure a great number of sisal slips as soon as possible in order to put the industry upon a commercial footing in Porto Rico. While other fibers, as maguey, sansevieria, and abacá, will grow in favored sections of the island, the yields are not to be compared with those obtained from sisal.

FRUITS.

The plantings of fruits have been very rapidly extended, especially with citrus fruits and pineapples. These plantings are made almost altogether with foreign capital, and by people from the States, especially the Florida planters. From the results obtained in groves of citrus fruits now coming into bearing, there is no doubt that very fine fruits of this class can be produced here. Porto Rico has demonstrated the fact that it is peculiarly adapted to the production of the pineapple, and very fine, luscious fruits can be grown here at a very low cost. Several million plants have been set during the year, mainly of imported slips of the Red Spanish variety from Cuba and Florida. The planting of

the large native pine called "Cabezona" has also been greatly extended. While the larger part of this variety is canned, some successful shipments have been made to the New York market.

LIVE STOCK.

There is great room for improvement in the various classes of live stock in Porto Rico. Very little pure-bred stock has been imported since the time of the early Spanish discoverers, and the result is that there has been very little improvement in the quality of the animals.

From the results reached at the experiment station and on the plantations there seems no doubt that improved animals of the various breeds can be imported and successfully acclimated. There is also no doubt that the breeders can greatly improve their animals and obtain greater profits by wise importation of new blood. Certain points, however, must be observed in acclimating animals from the temperate zone, or losses will occur.

The horses of Porto Rico are small but wiry. Some of them are very handsome and of great endurance, but in the States animals of the size common here would be classed as ponies. They are especially adapted for riding purposes and go the easy gaits very readily. In importing horses into the island those breeds that are inclined to fleshiness should be avoided; a better type is the medium-sized lighter specimens of the standard bred or trotting horse and the American saddle-bred horse. Moreover, this type crosses better with the native animals, as they are nearer the same conformation. Even with these animals, however, in any extensive breeding operations monstrosities occur; that is, animals not well proportioned in their various parts.

While the importation of pure-bred animals from the States means a great deal for the improvement of the native stock, it should, at the same time, be borne in mind by our planters that great improvement can also be reached by selecting their breeding animals with more care. This is a point that has been too greatly neglected in the past.

Many of the native cattle, considering the lack of care in breeding, are excellent individuals. The first requirement of the cattle of the island has been for work animals, and the beef and milk functions have been disregarded in any scheme of improvement. The animals, when they mature, which is rather late, make splendid work oxen on the cane plantations. To improve the race for beef or for milk production the shortest way is to import pure-bred bulls.

Imported animals should be kept in stables and fed cut grass, or, at least, should be kept in small lots well shaded until they become thoroughly acclimated. The second generation will probably be found as well acclimated as the native race, but animals brought from the States

will not thrive if allowed to run in the hot sun and to have only the coarse grasses usually obtainable.

Pigs, turkeys, geese, ducks, and chickens have been acclimated without any serious losses at the station. The hatching of poultry, both under hens and in the incubators, has been carried on during the dry season and has been fairly successful. During the rainy season heavy losses of young chickens have been reported from several sections of the island. Breeders are advised to confine hatching operations to the dry season for fowls and to properly protect them from the rains, and especially the damp grasses.

AGRICULTURAL CONDITIONS IN THE PROVINCE OF NUEVA ECIJA.[1]

By PABLO TECSON Y OCAMPO.

San Isidro, the capital of Nueva Ecija Province, is a rice, tobacco, sugar-cane, and corn producing town. I visited several localities in the neighborhood of this town and the appearance of the fields confirmed the information previously given me as to the shortage of the rice crop, which is the leading product of the town. The shortage, which is estimated to be about 85 per cent of a normal crop, was caused by drought.

Cabanatuan, which also produces rice, tobacco, and corn, has sustained a loss of approximately 85 per cent of the rice crop. In this town there are large areas suitable for the cultivation of sugar cane, tobacco, and corn that are now lying idle.

The towns of Santa Rosa and San Leonardo, where conditions are similar to those of Cabanatuan, have also suffered from shortage in rice production because of drought. Cocoanuts, coffee, and cacao thrive in these towns, but the people do not pay any attention to the cultivation of these crops.

Boñgabon, which has two irrigation canals deriving water from the Pampanga and Santol Rivers, both of which furnish abundant water throughout the year, and also numerous springs, did not suffer at all. The rice crop in this town is uniformly fair every year. Cocoanuts grow well in Boñgabon, and there is no doubt but that coffee, cacao, and abacá would prove successful if the people would devote themselves to the cultivation of these crops. Notwithstanding favorable soil conditions the area of land under cultivation is far exceeded by the uncultivated area, and the area of public land is still more extensive. During the rainy season water transportation is available for moving such products as there are for export.

Pantabañgan is a very poor town, due principally to its remote location and lack of satisfactory transportation facilities. Deer and wild hogs, together with a scanty annual crop of rice, furnish the main food supply.

[1] Report of the superintendent of agricultural extension work of the Bureau of Agriculture on a recent investigation of the agricultural situation, with particular reference to the rice crop, in the Province of Nueva Ecija.

Carrancalan, like Pantabañgan, has no transportation facilities, but it has large areas of rice fields provided with irrigation canals. Cocoanuts, cacao, and coffee grow well, but are cultivated only on a limited scale. Tobacco and corn are also raised in this town.

Conditions in the town of San José are similar to those of Carrancalan, excepting that its products can be transported by carts to the railway station at Cabanatuan. It has, furthermore, extensive areas of public land provided with a water supply. Tobacco, corn, and sugar cane are grown in San José, but only to a small extent.

The town of Talavera has land suitable for growing rice, tobacco, sugar cane, cocoanuts, cacao, and coffee. There are, however, large tracts of uncultivated land, and a very large area of public land. The latter includes forests, which contain different kinds of valuable timber trees. This town has an abundant water supply furnished by a large spring and the Talavera River. Should the agricultural conditions in this town ever be improved, it would undoubtedly become one of the leading towns of the province, as it is located close to Cabanatuan where both land and water transportation are available. Talavera is one of the towns of Nueva Ecija that has lost about 80 per cent of the rice crop.

The principal industry in the town of Peñaranda is the cultivation of betel (ycmo). The rice lands are limited in area and of poor quality. These lands are crossed by two rivers, one of which is fairly large, and both of which can supply abundant water throughout the year. This town, also, has sustained a shortage of about 80 per cent in the rice crop.

Gapang is one of the great rice-producing towns of Nueva Ecija Province, though tobacco, sugar cane, betel, and corn are also grown. shortage in the rice crop in this town is approximately 90 per cent.

The towns of Cabiao and Jaen, which produce the same crops as Santa Rosa and San Leonardo, have also suffered from drought. The loss in these towns is estimated at 67 per cent.

In San Antonio rice, tobacco, betel, and buri are the important crops. A large number of buri palms are grown in this town, the products of which are utilized not only in San Antonio but also in neighboring towns. This palm yields a number of valuable products, among which may be mentioned a nutritious flour-like substance (yuro), a beverage (basi), and a sirup (miel). The fibrous leaves are extensively used for making mats and hats. The shortage in the rice crop in San Antonio has been about 60 per cent.

Aliaga and Zaragoza are rice-producing towns, which have been damaged to about the same extent as have Cabiao and Jaen. There is a river which furnishes an abundant water supply in Aliaga and Zaragoza, and some of the property owners have made use of this supply. The majority of the people, however, have neglected to do this and have lost nearly 90 per cent of their rice crop.

Licab, which is a rice and corn producing town, has suffered a shortage in the rice crop equal to that of Aliaga and Zaragoza, although an abundant supply of water was available from a river. Had the people not been expecting rain this loss could undoubtedly have been averted. Fortunately large areas are now planted to corn, sweet potatoes, and vegetables, and the planting of these crops is still being continued. The products thus obtained will, in a measure, take the place of the rice crop.

San Juan de Guimba has sustained a loss of about 60 per cent of the rice crop. This town has two rivers that can be used for irrigation purposes. The water from one of these rivers has been utilized during the past year, and the lands thus irrigated gave a good crop. On lands not irrigated there has been a loss of 90 per cent. This town also contains land suitable for the cultivation of cocoanuts, cacao, and coffee.

In Cuyapo and Nampicuan, which are rice-producing towns, nearly all of the land under cultivation belongs to private owners. The shortage in the rice crop in these towns is estimated to be about 67 per cent.

In all of the towns in Nueva Ecija there has been a great shortage in the rice crop, but no disease has been reported among live stock. In many of the towns in this province cocoanuts, cacao, coffee, kapok, maguey, and cotton might be advantageously grown. This fact has been brought to the attention of farmers and property owners throughout the province, and they have been advised to encourage the cultivation of these crops.

The great shortage in the rice crop during the past season in the Province of Nueva Ecija was due to drought. Owing to the irregularity of the seasons this disaster is liable to occur any year, and the only effective remedy that can be suggested is the extension of irrigation systems.

The rivers of Nueva Ecija will furnish an abundant supply of water for irrigating large areas of land whenever irrigation canals shall be opened so that this water can be utilized. The towns of San Isidro, Gapang, Cabiao, part of Peñaranda, and San Miguel de Mayumo in Bulacan can be irrigated from the large Peñaranda River; the towns of San Leonardo, Santa Rosa, Cabanatuan, and part of Peñaranda from the small Peñaranda River and Tabuating Creek; and the towns of San Antonio and Jaen from the Pampanga River and Papaya Creek.

There can be no doubt but that the opening of irrigation canals, as above suggested, would be a great benefit to the towns mentioned; and would effectually prevent a repetition of a rice-crop failure such as has occurred in Nueva Ecija during the past year.

PLATE II. THRASHING RICE BY TRAMPLING WITH CARABAOS.

HOG CHOLERA.

By David G. Moberly, *Veterinarian.*

DEFINITION.

Hog cholera is a contagious disease of swine characterized by a continuous fever, ulceration of the intestinal tract, and reddish discoloration of the skin on the ventral surface of the body and the inner surface of the thighs.

HISTORY.

Hog cholera has existed in central Europe and America since the first half of the nineteenth century. Its nature has been better known since 1850, when it was carefully described by Dr. Sutton, in the United States. In 1885, Salmon and Smith isolated and described a bacillus which they considered the exciting cause of the disease.

It is not known when the disease made its appearance in the Philippine Islands, but reports from farmers afford evidence that it must have existed here for many years prior to American occupation. The writer found the disease in the Province of Bulacan in the latter part of 1901. The disease was widely distributed throughout the province at the time, destroying thousand of animals.

Dr. David G. Kretzer was the first to make an investigation of the disease for the Philippine Government, which was done at Angat, Bulacan, in 1903, where he reports five hundred hogs dying in one month. Since this outbreak the malady has been reported from nearly every province in the Archipelago, and the swine industry in some places has been practically ruined. The infection is now widespread throughout the islands.

CAUSE.

The exact cause is unknown. For many years hog cholera was thought to be the *Bacillus cholera suis,* a small, nonspore-bearing aërobic bacillus, rod shaped with rounded end, motile and possessing flagella. The size varies according to the culture media in which it is grown, but is generally from 1.2 to 2 micromillimeters in length and from 0.5 to 0.8 micromillimeters in width. But in 1905 the United States Department of Agriculture, by numerous experiments and much research work, proved that the direct cause of hog cholera is a filterable virus, and not the *Bacillus choleræ suis* as was formerly supposed, though the bacillus is associated with the disease in the majority of cases.

SYMPTOMS.

The symptoms of hog cholera are varied, few cases presenting identical clinical pictures. For convenience sake we will divide the disease into acute, or septicemic, and chronic forms.

Acute cases are rarely diagnosed in life, as this form runs a rapid course. The first evidence of the disease noted is the indifference of the animal to its surroundings; the animal may or may not lose its appetite. In some cases the animal eats until within a few minutes of death. As a rule they prefer to lie quietly in a corner to themselves, or may huddle together, burrowing their heads under the litter. In the acute type death generally comes in a few hours. Rarely does the animal live more than a day or two. They refuse to move when disturbed and seem to be oblivious to their suffering.

During the first stages of the disease the animal is usually constipated, but later there appears a greenish diarrhea, which persists until recovery or death takes place. The pulse is hard to determine as well as the respiration. The temperature is generally from 101° to 103° C. Cough is rare except in chronic cases. The skin around the nose, ears, and abdomen presents a reddish hue. The mucous membrane of the eyes is generally reddened, and sometimes there is a discharge from the eyes.

The chronic form begins in about the same manner as the acute. The appetite remains fair. The animal rapidly becomes emaciated and near the end staggers in its gait. Sometimes tremors and chills are noticed. Diarrhea is generally present the last few days. The symptoms vary to such an extent that diagnosis is difficult. It often becomes necessary to make post-mortem examinations to establish the diagnosis, and sometimes bacteriological examinations must be resorted to.

Diagnosis of hog cholera is difficult, owing to its varied course. In typical cases the animal becomes listless, seeks a quiet corner, lies down most of the time with head buried under litter. There is redness of the skin around the nose, ears, and abdomen and between the thighs. The affected hogs become exhausted on slightest exertion and breathe with great difficulty. The rapid course and spread of the disease among exposed animals is cause for suspicion, and post-mortem examinations should be made.

This disease is to be differentiated from various intestinal troubles and poisonings which may exhibit similar symptoms, as well as swine plague—in fact, the latter is often described with hog cholera as one and the same disease, and is about the same in importance. Swine plague is prevalent in the Philippine Islands. It differs from hog cholera only in the seat of infection, which in the former is the pulmonary cavity while the latter is in the intestinal tract. Each present a hemorrhagic

form in acute cases, when the post-mortem lesions are similar. Differential diagnosis is only determined by post-mortem and bacteriological examinations.

PATHOLOGY.

The lesions presented in the acute form of hog cholera are purely septicemic in nature, and of a hemorrhagic type. The cortex of the lymphatic glands shows extravasation of blood or hemorrhagic areas, giving the appearance of a dark-colored band covering the inner substance of the gland. The glands most generally affected are the brachial, meso-colon, and the retroperitoneal. The gastric and mesenteric may also be affected. Hemorrhages are frequently found beneath the serous surfaces of the abdomen and thorax, generally appearing in small spots; they are sometimes found under the mucous membranes of the intestines, and under the peritoneal surfaces near the kidneys and costal pluera in large extravasations an inch or more in diameter. The surface of the skin shows hemorrhagic blotches.

The kidneys are nearly always the seat of interstitial hemorrhages, sometimes very extensive. The glomeruli appear on the surface of the kidney as blood-red spots. Beneath the skin over the ventral surface may be found small dotted hemorrhagic areas.

The spleen is usually soft and pulpy, engorged with blood and enlarged to nearly double its normal size.

Extensive lesions are to be found in the digestive tract. The stomach is deeply reddened near the pyloric end, and there may be hemorrhagic blotches over the surface. Sometimes submucous hemorrhages are found along the entire length of the intestines. In Europe and America chronic cases are the most common form, but in the Philippine Islands the acute form is mostly encountered, especially in the slaughterhouse and hog corrals in Manila.

In acute cases the intestinal lesions are not so pronounced as in the chronic form. In chronic cases the principal lesions are found in the digestive tract, especially in the large intestines, and take the form of necrotic areas or ulcers. In the beginning of the necrotic process the ulcers appear as slightly projecting masses, generally blackish in color, though they may be striped with yellow or grayish tints; later they are depressed, presenting ragged edges. If the surface is scraped away the base of the ulcer is of a whitish color. The ulcerations are generally circumscribed in form, varying in size from one-sixteenth to one-half inch in diameter. Occasionally, however, they may involve the entire mucous surface, having the appearance of diphtheritic membranes.

As a rule the necrotic areas are found only in the anterior half of the colon, in the cecum, and around the ileo-cecal valve. Sometimes the chronic and acute forms present nearly the same lesions. The hemorrhages as described in acute cases may be present in the chronic form.

DURATION.

The duration of this disease varies considerably; in the acute type from a few hours to a day or two days at most, while the chronic type lasts much longer, generally from six to fourteen days.

PROGNOSIS.

The prognosis of hog cholera is not favorable. The mortality is from 50 to 100 per cent. In most outbreaks about 80 per cent of all animals exposed succumb to the disease.

CURE AND PREVENTION.

Nearly every known remedial agent has been used in the last half century for the treatment of hog cholera, but with little success. However, a degree of success has been obtained in the United States by the use of the serum treatment, though not to such an extent as to warrant the production of the serum in the Philippines until further advances have been made along that line of treatment.

Prevention is the only really successful means by which the disease can be controlled, and as hog cholera is caused by a specific organism, or virus, the source of infection must be located and proper sanitary measures taken to check its spread. Infection is generally carried from an infected district to a noninfected district through the traffic of the live animals. They are often infected when shipped and develop the disease after arriving in the market. All authorities agree that the period of incubation of hog cholera is from four to fourteen days; therefore, all swine shipped into a noninfected district, coming from an infected district, should be quarantined for a period of not less than two weeks.

Infection may also be carried on the shoes of persons, by feed, or even other animals, such as cattle, horses, etc. Another important source of infection is running streams of water, creeks, and the like; for instance, a stream of water where hogs are admitted to wallow, and passing through an infected district, will carry infection to all places below. The virus of hog cholera will live in water from two to six months, and will retain its virulence for many weeks in the soil. When this disease is suspicioned all attacked and exposed animals should be disinfected in a mild solution of such agents as creolin, lysol, or any other of the coal-tar disinfectants. Corrals should be thoroughly disinfected, all litter burned, and the healthy animals isolated in a new corral under strict quarantine. No swine should be allowed to wallow in mud holes or inhabit the places where infected animals had been two weeks prior to their showing evidence of the disease.

Adequate quarantine measures, rigidly enforced, between infected districts and noninfected districts are the only means by which hog cholera can possibly be eradicated.

SCHOOL GARDENING IN THE PROVINCE OF LA UNION.[1]

Last year, during the month of January, a contribution list for the purchase of seeds was begun in each school. No assessments were made, and no amount stated as desired. As a result of this effort we soon had on hand about ₱35 of seed money. I personally assured each pupil a garden and seed for the same. Every teacher was required to keep a list of the names of all pupils who contributed and the amount. This list is filed in my office and is now used in the distribution of seeds to pupils for home gardens. In no case was there a contribution of more than 5 centavos, and the most of the contributions were 2 and 3 centavos each. Eggs, cocoanuts, pineapples, etc., were accepted and sold in the markets. The sum raised was spent chiefly with a firm in Chicago and one in Los Angeles, for the purchase of about 50 pounds of seed, which arrived by mail during the month of May. The seeds consisted of seventy-four varieties, many of which were unknown in the Philippines. I found it advantageous to buy in bulk, as in this way you get many more seeds for a given amount of money, and many of our varieties were received in one-half and one-fourth pound packages. The seeds were divided among the different barrios according to the amount of contribution, and all schools have had many varieties to give the pupils for planting at home.

As a means of encouragement I shall offer a prize to the pupil who raises the finest specimen of each thing planted. Pupils are permitted to submit in this competition products from their home gardens, as many of the pupils have home gardens, which I personally inspect and encourage as much as possible. If a pupil can produce better plants in his home garden than we do in the school garden I want to know it, and also how it was done.

I now have on my hands one more garden in Tubao than was desired. The first-grade pupils were told that they would have no garden, as they were too small. This announcement brought forth requests, petitions, and a few tears, until I told the children in this grade to go to work. To have seen pupils 7 or 8 years old carrying bamboo and working their plots would convince anyone that the Ilocanos are agriculturally inclined.

A garden is now found at every school and is part of the school work. The central school of Aringay has an excellent flower garden, containing

[1] Extract from report of Mr. North H. Foreman, supervising teacher, Lubao-Aringay, La Union.

many beautiful flowers; also some experimental plats and a vegetable garden. The central school of Tubao has two large gardens. All of these gardens are located near the schoolhouse, in most cases adjoining the schoolhouse.

The general arrangement was to assign a certain part of the garden to each class, the teacher in charge of the class also having charge of the garden. I found that awakening a certain amount of class rivalry lent interest to the work. In the central schools the teachers have immediate charge, but in barrio schools each class chooses a leader, the teacher having an oversight of the work. This was found necessary, as the barrios contained but one teacher each.

The part of the garden assigned to each class was subdivided, and each member of the class was given a small plat. That plat was his. He planted what he liked, and all of the work in preparing the ground and cultivating the plants was done by himself. This arrangement gave each individual pupil a definite ownership. In the assignment of plats, both boys and girls were included.

PREPARATION OF GARDEN.

No difficulty was experienced in securing the necessary land, and I found it best to build with school labor the fences required. Each pupil in the school donated a portion of the bamboo needed, and the older boys, under the guidance of the teacher, built the fences.

Every garden in my district was fenced by the pupils. These fences were built in July, after which no more "general" work was done, each pupil being interested in his own plat and working on it alone. As the rains are heavy, borders were placed around each plat. These borders were made of rock, brick, bamboo, or sod, the material that was most plentiful in the barrio being used. Numerous wide paths were made so as to give the pupils ample room for their work without stepping on the beds.

FERTILIZERS.

The kinds and uses of fertilizers were taught and each pupil was required to fertilize his own garden, some of my best gardens having been on worn-out land. The pupils carried fertilizer in baskets from their homes. After the ground was prepared to a depth of 8 inches, the seeds were planted. In order to give needed instructions in the preparation of seed beds a part of each pupil's garden was used as a seed bed.

CARE OF GARDEN.

Each pupil was required to have at the school some vessel for carrying water. Some of the schools had water close at hand and in others it was necessary to carry the water nearly 1 mile. The girls usually brought water in jars, while the boys used a long bamboo; in two barrios nothing

PLATE III. CABBAGES GROWN AT THE SINGALONG EXPERIMENT STATION.

but bamboo was used. Each school had one or more sprinklers. Some plants required daily watering and others were watered once every two days. On Saturdays and other holidays a committee was chosen from each class to water the class garden, but many pupils preferred to come and water their own plat rather than trust a committee.

RESULTS.

When the products were ready to be used the pupils were encouraged to take them home, each pupil having been previously instructed in regard to their use. Many a proud boy or girl trudged home with three or four radishes, beets, or turnips, but no pupil was permitted to take all of any one kind from his garden. At least one plant was left for seed, each pupil being required to save seed from each kind planted in his garden. This seed was divided into two equal parts, one part for the pupil, the other to be kept for the school garden next year. Pupils were taught that saving of the seed was quite as essential as the planting of the garden.

I will not attempt to attach a list of all plants that were grown in these gardens, but the following is a general summary:

	Varieties.
Aringay:	
Vegetable garden	52
Flower garden	126
Experimental plats	12
Cava:	
Vegetable garden	20
Santa Cecilia	37
Tubao:	
Vegetable garden No. 1	30
First-grade vegetable garden No. 2	50
Santa Tereza:	
Vegetable garden	35
Rizal:	
Vegetables	29
Anduyan:	
Vegetables	27
Ambangonan:	
Vegetables	18

Experiments were made in the experimental gardens with the following:

Broom corn: Grew well and had good long brushes. Winter wheat: Grew well, good head. Flax: Grew well, good stem and plenty of seeds. Spring wheat: Grew fairly well. Buckwheat: Grew well, but did not get large. Millet: Grew well, good head. Rutabaga: Grew well, good root. Sugar beet: Bad seed. Sugar corn: Only fair stand. Sunflowers: Large heads, some 18 inches across. Sage: Grew well, but was killed by animals. Pease: Failed, few pods.

INTEREST SHOWN.

In no case have I any complaint to make of lack of interest shown by pupils. All of the pupils were willing to work and felt slighted if not given a garden. As an example I give the following occurrence in Tubao: It was first intended to have only one garden in Tubao and have only second, third, and fourth grade pupils do garden work. The first-grade pupils objected to this arrangement and many in this grade cried when told that they would have no garden. I finally told them that they might have a garden if they would bring the materials for fences. The next morning every pupil came to school with one or more bamboos. Even little fellows 7 years old brought a long bamboo. The larger boys of the grade built the fence. A corner of the plaza was utilized, and in three weeks every pupil in the school was working in his individual garden. Absolutely every pupil in my district does garden work.

In most cases the teachers have shown great interest in this work. With possibly two or three exceptions, the teachers have carried out my instructions, as the flourishing gardens show.

The parents have shown a creditable amount of interest, often visiting the gardens. In only two cases have I had parents object to their children working in gardens. These objections were easily settled by a little explanation as to the individual ownership of the gardens.

I find that the hardest problems I have had were the stealing of the plants from the gardens and insistence upon frequent waterings. The barrio of Cava being on the main road and no houses near the gardens, the plants were stolen by people who were passing. I also had considerable trouble in the barrio back in the hills among the "bagos." The barrio of Ambanganon was constantly depleted by thieves. There was also some difficulty in getting teachers to give minute attention to all detailed instructions about the watering of plants.

SUMMARY.

First. The garden work was done willingly by all pupils.

Second. Attention was given the gardens on Saturdays and holidays.

Third. All gardens were owned by the pupils and the products were the property of the pupils raising them.

Fourth. Instruction was given in the use of fertilizers, cultivation of plants, use of products, and the saving of seeds.

Fifth. Garden work was done outside of school hours.

Sixth. It is believed that the gardens have been a success and a great benefit to the pupils in teaching them industry, and to the parents and the community at large by the introduction of new food plants.

Seventh. All that is necessary for a good school garden is plenty of hard work and close supervision on the part of the supervising teacher.

Eighth. Previous to the starting of our school gardens, radishes, lettuce, beets, endive, carrots, rutabaga, kohlrabi, turnips, and many other of the plants grown, were unknown as food plants in my district. Now you will find many of these planted at the homes of the pupils.

Ninth. The only restrictions were that each pupil prepare the soil, cultivate the plants, and save seeds according to instructions. The success of the work I attribute largely to the fact that each pupil was given his own individual plat, thus giving him a definite ownership, and a right to use or sell the products of his garden.

COMMERCIAL ORANGE PRODUCTION IN THE PHILIPPINES.

By William S. Lyon.

Inquiries for buds or scions of improved varieties of American or European oranges are so frequently addressed to the Bureau of Agriculture that, as a matter of general interest and information, a brief résumé of the experiences of the Bureau with these varieties is here made public.

Early in 1902 the standard sorts in common cultivation in Florida, California, Malta, Italy, and Japan were introduced and planted at Malate, Manila, at sea level; also near Abucay, Bataan Province, at an elevation of about 200 meters; and at La Trinidad, Benguet, at an altitude of 1,500 meters. The story is best and most briefly told by saying that the results have been so far most disappointing. The trees were, in trade jargon, "two-year buds" and are now approximately 6 years old, and under fair condition should be producing one and one-half boxes (200 to 300) oranges per tree. The Japanese varieties are the only kinds that have proven productive, but the fruits have deteriorated so badly as to be hardly edible, and are practically worthless.

Of the other foreign varieties, those planted in Benguet Province have nearly all died, and those in Bataan, though grown upon an inviting-looking soil with good drainage and protection from high winds, have fared but little better. In Manila, the trees of most varieties have made a fair growth, but only one tree (a St. Michael sweet) has matured any fruit and of that only to the number of three. The Valencia late, Malta blood and the famous Washington navel have, up to the age of 6 years, not fruited. The three fruits of St. Michael sweet were quite up to standard in all respects, except color, remaining bright green when otherwise perfectly mature. This last feature was to be expected, and, while we are not prepared to say that there are no places in the Philippines where these foreign varieties may not prove productive, the prospective planter should fully realize that he can not hope to produce anything but bright-green uncolored fruits. This, from a commercial aspect, is a more serious defect than is apparent at first glance. The eye does much to influence the palate, and the influence is clearly shown in the higher price generally brought for the brilliant, highly colored California

navels over the intrinsically finer fruits from Jamaica and Florida, handicapped as these latter are by the dull greenish russet color which characterizes oranges grown in the Tropics.

This feature is common to the Philippines as well as to all tropical countries. We see it in the closed-skinned "cajel" so common throughout the Visayas and in the free-skinned tangerine or "naranjita" so abundant at certain seasons in our markets.

These oranges are at their very best while still bright green. When beginning to color, as they do toward the close of the season, it is an index of incipient decay which may not be exhibited in disintegration or in anything worse than loss of juice and flavor.

The experiences of all orange-growing countries conclusively show that the orange, although cosmopolitan in the mere matter of existence, is most fastidious in the soil requirements which bring its fruit to perfection. Witness the heavily loaded trees in and about Santa Barbara, California, whose fruit is discarded while the local markets are supplied with fruits brought from Los Angeles and Riverside counties—100 or more miles away. Nearer home, note the superlative excellence of the naranjitas grown at Tanauan and at Santo Tomas, and observe how utterly inferior is the fruit of the same tree grown at near-by Calamba, and still worse on seemingly like soil at Lipa—less than 15 kilometers distant.

On this account it is not denied that in this particularly favored district satisfactory results may be achieved with imported varieties of oranges, with the odds nevertheless greatly in favor of better success being obtained through careful selection and cultivation of the native tangerine. It is not claimed that this orange is free from defects, but these defects could be partly eliminated in a single generation of careful seed selection in the orchard. In the commercial essentials of productiveness, juiciness, flavor, and shipping qualities, these oranges are unexcelled; and the selected fruits of Santo Tomas or Tanauan at their prime are superior to the showy but insiped California fruit that reaches this market in cold storage.

From ex-General Malvar, a large grower in Batangas, we learn that there are many thousands of hectares of typical orange lands still unplanted to orchards, which offer an inviting field to the planter; especially to the one who would grow only selected stocks, and improve a little on the spontaneous methods now in vogue. The writer saw a single tree in Tanauan the crop of which sold for ₱10 on an estimated yield of 2,000 oranges, or one-half centavo per orange. As a few dozens of selected fruits from this tree sold for 24 centavos per dozen, there is hardly a doubt that, had the tree been thinned down to one-half (which could have been done at a cost of less than ₱1), the remaining thousand fruits would have found a quick sale at 1½ to 2 centavos apiece, giving a net return of ₱14 to ₱19 for the tree instead of ₱10.

The orchard value of these fruits, "as they run" in seasons of great abundance, is seldom under ₱5 per 1,000, and more generally is ₱8 to ₱10, rising to double these figures in time of scarcity. The grower need scarcely consider the question of a surplus and consequent glut. The Chinese are exceedingly fond of these oranges and there is a ready export market to Hongkong for many million fruits, whenever the price falls low enough to permit of shipment and still leave a handsome margin for the producer.

THE WORLD'S RICE CROP.

The following article on the world's production of rice is published in the Agricultural News for May 4, 1907.

It is stated in The World's Commercial Products: Asia is the most important rice-growing region of the world, for, excepting in the northern portions of this continent, rice is universally cultivated. Three-quarters of all the rice that comes into the markets of the world is grown in British India, Bengal producing the greatest amount. Siam, China, Japan, the Straits Settlements, Ceylon, the Hawaiian Islands, and other Asiatic countries all produce large quantities of rice, although not sufficient in every case to supply the local demands.

A correspondent in Mincing Lane, London, has supplied interesting figures and information in regard to the world's rice crops, from which the following is a brief extract:

In China rice is very extensively cultivated. No reliable statistics have ever been published as to the production, but this is much less than the demand, and, consequently, large quantities are imported from Siam and Saigon. The total imports from these two countries amounted to 731,286 tons in 1904.

The average production of rice in Japan during the ten years 1894–1904 was 6,300,000 tons. The average amount exported during the four years 1901–1904 was 61,708 tons, while 512,164 tons were, on the average, imported annually during the same period. Rice consumption is increasing rapidly, and Japan promises to become the largest eastern buyer of this product.

Turning to India, we find that 19,152,665 tons of rice were produced in Bengal and Madras in 1904. Rice is also cultivated on a smaller scale in other provinces, but no exact figures are obtainable. There was exported from India to Europe, during the three years 1902–1904, an average of 65,631 tons. Calcutta also exports rice to Ceylon, Mauritius, South Africa, and Australia, the total being probably about the same as that of the shipments to Europe. In 1904, 249,000 tons were imported from Burma for Bombay and Cochin (on Malabar coast). It is observed that India's rice exports are tending to fall off, while the imports are increasing.

The rice crop of Cochin-China amounts to about 1,500,000 tons; of this some 636,000 tons are yearly exported, chiefly to France. The cultivation of rice is extending yearly.

The probable production in Siam, where rice cultivation is also extending, is 2,000,000 tons, of which 689,510 tons are exported. In Burma the crop is estimated at 3,300,000 tons. Of this amount 2,182,000 tons are annually exported, 981,000 tons going to Europe. The great bulk of Europe's rice supply is drawn from Burma, whence the product is also largely shipped to Japan, India, the Straits Settlements, and Java.

Java produces about 4,250,000 tons of rice, exporting 39,656 tons. Java exports only the best qualities and has to import from Cochin-China, Siam, and Burma on an increasing scale for her own consumption; thus, the average importation for the three years 1902–1904 was 138,000 tons.

Of late years the cultivation of rice in the Gulf States of America has been rapidly increasing. In 1904, about 400,000 tons were produced. No exact figures are available as to the exports of this commodity from the United States, but some 30,000 tons are shipped each year to Porto Rico, and in the year 1904–5 some 7,000 tons went to Europe. The Northern States import cleaned rice from the United Kingdom and the Continent—particularly granulated rice—in all, 20,000 to 30,000 tons annually.

Consequent upon the introduction of East Indian immigrants into the West Indies and British Guiana, rice has become a crop of some importance, more particularly in British Guiana, where there were in 1905–6, 23,853 acres under rice cultivation, which yielded 17,443 tons. It is anticipated that the production of rice in British Guiana will shortly be in excess of the local demands, and already endeavors are being made to find an outlet for the product in the neighboring West India Islands.

PLATE IV. A NATIVE BAMBOO HEMP PRESS.

RANGE OF PRICES OF PHILIPPINE AGRICULTURAL PRODUCTS.

Lowest, highest, and average prices of palay, abacá, copra, sugar, tobacco, and corn for the month of December, 1907.

Province.	Palay, per cavan.			Abacá, per picul.			Copra, per picul.		
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.
Albay	₱3.00	₱3.50	₱3.25	₱7.00	₱10.00	₱8.50	₱5.50	₱6.00	₱5.75
Ambos Camarines	2.50	4.50	3.50	5.00	13.50	9.25	5.00	7.50	6.25
Antique	1.50	3.12	2.31	18.00	18.00	18.00			
Bataan	1.50	3.50	2.50						
Batangas	1.50	2.50	2.00	20.00	20.00	20.00			
Bohol	2.00	7.00	4.50	8.00	20.00	14.00	3.30	9.00	6.15
Bulacan	2.50	3.40	2.95						
Cagayan	3.00	7.00	5.00						
Capiz	1.50	2.50	2.00	10.00	10.00	10.00	6.00	6.00	6.00
Cavite	3.00	3.00	3.00	20.00	24.00	22.00			
Cebu	2.50	5.00	3.75	17.00	25.00	21.00	7.00	9.50	8.25
Ilocos Sur							5.00	5.00	5.00
Iloilo	2.50	6.00	4.25	28.00	30.00	29.00	6.00	6.00	6.00
La Laguna	2.00	3.00	2.50	8.00	12.00	10.00	6.50	7.40	6.95
La Union	5.50	5.50	5.50				9.00	9.00	9.00
Leyte	2.50	3.25	2.87	11.00	16.00	13.50	6.00	8.00	7.00
Misamis	2.50	3.00	2.75	8.50	11.00	9.75	6.00	7.50	6.75
Nueva Ecija	2.00	3.20	2.60				7.00	10.00	8.50
Occidental Negros	2.00	2.75	2.37	18.50	24.00	21.25	5.50	10.00	7.75
Oriental Negros	3.00	5.00	4.00	11.00	15.00	13.00	8.00	8.00	8.00
Pampanga	2.50	3.50	3.00						
Pangasinan	2.00	5.75	3.87				6.00	10.00	8.00
Rizal	2.10	3.50	2.80						
Romblon	2.50	2.50	2.50	16.27	22.00	19.13	5.00	7.50	6.25
Samar	3.00	5.00	4.00	12.00	16.50	14.25	6.00	6.50	6.25
Sorsogon	2.50	4.00	3.25	7.00	20.00	13.50	5.50	7.00	6.25
Surigao	3.00	3.00	3.00	14.00	18.00	16.00	7.25	8.50	7.87
Tarlac	2.00	2.15	2.07						
Tayabas	2.50	5.00	3.75	9.50	24.00	16.75	5.00	5.50	5.25
Zambales	1.80	2.50	2.15						

Province.	Sugar, per picul.			Tobacco, per quintal.			Corn, per cavan.		
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.
Albay							₱4.00	₱4.00	₱4.00
Ambos Camarines							1.50	1.50	1.50
Antique	₱2.50	₱2.50	₱2.50						
Bataan	5.00	5.00	5.00				1.50	1.50	1.50
Batangas	2.00	4.00	3.00	₱8.00	₱8.00	₱8.00			
Bohol	3.00	4.00	3.50				2.00	3.50	2.75
Bulacan	4.75	4.75	4.75				2.00	2.10	2.05
Cagayan				10.00	10.00	10.00	1.25	1.25	1.25
Capiz	3.00	3.00	3.00	4.50	8.00	6.25	1.25	1.50	1.37
Cebu				4.00	30.00	17.00	2.00	4.00	3.00
Ilocos Norte	4.00	6.00	5.00	20.00	20.00	20.00	1.50	4.00	2.75
Ilocos Sur	1.50	6.00	3.75	3.00	12.00	7.50	2.00	4.00	3.00
Iloilo	4.37	4.37	4.37	7.00	7.00	7.00	2.50	5.00	3.75
La Laguna	3.50	3.50	3.50				1.75	1.75	1.75
La Union	4.00	4.00	4.00	4.00	4.00	4.00	3.00	3.00	3.00
Lepanto-Bontoc							5.00	6.25	5.62
Leyte							1.50	2.50	2.00
Misamis				.80	20.00	10.40	2.50	2.50	2.50
Nueva Ecija				1.50	9.00	5.25	2.00	2.50	2.25
Occidental Negros	2.50	4.00	3.25	20.00	20.00	20.00	2.00	2.50	2.25
Oriental Negros							2.50	3.00	2.75
Pampanga	3.00	3.00	3.00						
Pangasinan				4.00	33.33	18.66	2.00	5.00	3.50
Rizal									
Romblon				6.00	6.00	6.00			
Sorsogon	3.00	3.00	3.00				1.50	3.00	2.25
Surigao				15.00	15.00	15.00			
Tarlac	2.20	5.00	3.60				2.00	2.50	2.25
Zambales	5.00	6.00	5.50						

Hon. B. Wallace

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Bureau of Agriculture.

SEED AND PLANT DISTRIBUTION.

MAGUEY PLANTS.

For the guidance of those wishing to secure maguey plants from the Bureau of Agriculture the following statement is issued:

PLANTS FOR DISTRIBUTION.

The Bureau has ordered from Hawaii, with the promise of delivery in June, July, and August, 1,000,000 pole plants and 500,000 sucker plants.

The 60,000 nursery plants growing at Singalong will be ready for delivery in June and the 350,000 native nursery plants growing at Lamao will be ready for delivery in September and October.

DISTRIBUTION.

These plants will be distributed free of charge to parties requesting them, for their own use, as follows:

500 Hawaiian pole plants, or
200 Hawaiian sucker plants, or
400 Native nursery plants.

No free distribution will be made of over 500 plants to one person.

Parties wishing larger quantities will be required to pay for them at the following rates:

	Per 1,000
Hawaiian pole plants, - - - -	₱6.00
Hawaiian sucker plants, - - -	18.00
Hawaiian nursery plants, - - -	20.00
Native nursery plants, - - - -	6.00

Hawaiian nursery plants will not be sold in lots of over ten thousand to one person.

Parties ordering plants not on the free list should send post-office money order for amount of purchase.

Literature on the subject of maguey growing in the Philippine Islands can be secured from the Bureau of Agriculture.

CEARA RUBBER.

The Bureau of Agriculture has received recently a supply of Ceara rubber seed from La Granja Modelo, La Carlota, Occidental Negros. This seed will be distributed without charge, and persons desiring the same should forward applications promptly.

G. E. NESOM, Director of Agriculture.

THE PHILIPPINE

Agricultural Review

VOL. I | MARCH, 1908 | NO. 3

CONTENTS.

EDITORIAL.

The most vital question affecting the welfare of the farmers in the Philippine Islands to-day is that of controlling the common dangerous communicable diseases of domestic animals.

The ravages of rinderpest and surra in the Philippine Islands are too generally understood to require comment. From one end of the Islands to the other these diseases have destroyed thousands upon thousands of work animals. In many sections agricultural development has been almost paralyzed and the country as a whole has suffered incalculable losses.

An important part of the work, which has for its object the control of these diseases, is the education of the people. The farmer who knows the essential facts about a dangerous animal disease, and who understands and can utilize simple methods of treatment and disinfection, can usually hold a disease in check until outside help is obtained.

The present number of the REVIEW contains a series of papers on the common dangerous communicable diseases of domestic animals in the Philippine Islands, written by Dr. David G. Moberly, veterinarian of the Bureau of Agriculture, and edited and reviewed by the honorable the Secretary of the Interior, and the Director of Agriculture. These papers are a series of simple "questions and answers," and are in no sense

technical. They are published with the one object in view of furnishing the farmers of the Philippine Islands with elementary information on the subject of dangerous animal diseases.

On October 10, 1907, the following law to prevent the introduction and spread of dangerous communicable animal diseases in the Philippine Islands was enacted by the Philippine Commission:

No. 1760.—AN ACT To prevent the introduction into the Philippine Islands of dangerous communicable animal diseases, to prevent the spread of such diseases within the Islands, and for other purposes.

By authority of the United States, be it enacted by the Philippine Commission, that:

SECTION 1. For the purposes of this Act domestic animals are hereby defined as horses, mules, asses, cattle, carabaos, hogs, sheep, goats, dogs, deer, and circus animals or those intended to be used for show purposes.

SEC. 2. For the purposes of this Act a dangerous communicable animal disease is hereby defined as glanders or farcy, surra, rinderpest, hemorrhagic septicemia, hog cholera, foot-and-mouth disease, or any other acute communicable disease which may cause a mortality of over five per centum in the period of one month.

SEC. 3. It shall be unlawful for any person, firm, or corporation knowingly to ship or otherwise bring into the Philippine Islands any animal suffering from, infected with, or dead of any dangerous communicable disease, or any effects pertaining to such animal which are liable to introduce such disease into the Philippine Islands: *Provided*, That any such animal or effects may be permitted by the Director of Agriculture to enter the Islands under such conditions as to quarantine, cremation, or other disposal as he may direct, or which shall be deemed by him sufficient to prevent the spread of any such disease.

SEC. 4. It shall be unlawful for any person, firm, or corporation knowingly to ship, drive, or otherwise take or transport from one island, province, municipality, township, or settlement to another any domestic animal suffering from any dangerous communicable disease or to expose such animal, either alive or dead, on any public road, street, or highway where it may come in contact with other domestic animals.

SEC. 5. Whenever the Secretary of the Interior shall declare that a dangerous communicable animal disease prevails in any island, province, municipality, township, or settlement, and that there is danger of spreading such disease by shipping, driving, or otherwise transporting or taking out of such island, province, municipality, township, or settlement any class of domestic animals, it shall be unlawful for any person, firm, or corporation to ship, drive, or otherwise remove the kind of animals so specified from such locality except when accompanied by a certificate issued by authority of the Director of Agriculture stating the number and kind of animals authorized to be shipped, driven, taken, or transported, their destination, the manner in which they are authorized to be shipped, driven, taken, or transported, and their brands and distinguishing marks. Such certificate shall also state that the animals in question have been inspected by a duly authorized agent of the Director of Agriculture and found free from dangerous communicable animal diseases and shall give the date of such inspection.

SEC. 6. The Director of Agriculture is hereby authorized—

(*a*) To maintain inoculation, quarantine, and detention stations for domestic animals in such places as may be approved from time to time by the Secretary

of the Interior, and to place all animals arriving from foreign and domestic ports or interior places in quarantine for such time as he may deem necessary to prevent the introduction and spread of dangerous communicable animal diseases.

(*b*) To inspect all domestic animals arriving by boat, rail, or otherwise in the cities, ports, or places where quarantine stations are maintained and in such other places as he may deem necessary for the purpose of preventing the introduction and spread of dangerous communicable animal diseases within the Philippine Islands.

(*c*) To require that animals which are suffering from dangerous communicable diseases or have been exposed thereto be placed in quarantine at such place and for such time as may be deemed by him necessary to prevent the spread of such disease.

(*d*) To require the cleaning and disinfecting of any utensil, place, corral, yard, or building deemed by him to be infected with dangerous communicable animal disease, and to prohibit the keeping of any domestic animals in such place, corral, yard, or building until it has been placed in a sanitary condition.

(*e*) To require the cleaning and disinfecting of any boat, car, vehicle, or other conveyance deemed by him to be infected with dangerous communicable animal disease, and to prohibit its further use for transporting domestic animals until it has been placed in a sanitary condition.

(*f*) To coöperate with provincial and municipal boards in the suppression of dangerous communicable animal diseases and in the establishment and maintenance of municipal slaughterhouse and milk-inspection systems, the object of which shall be to prevent the slaughter and sale of animals having diseases or injuries of such a nature as to render the meats and other food products derived from them dangerous or unwholesome for human food.

SEC. 7. Whenever the Director of Agriculture shall order any animal placed in quarantine in accordance with the provisions of this Act, the owner of such animal, or his agent, shall deliver it at the place designated for the quarantine and shall provide it with proper food, water, and attendance. Should the owner or his agent fail to comply with this requirement the Director of Agriculture may furnish supplies and attendance needed, and the reasonable cost of such supplies and attendance shall be collectible from the owner or his agent.

SEC. 8. Any person violating any of the provisions of this Act shall, upon conviction, be punished by a fine of not more than one thousand pesos, or by imprisonment for not more than six months, or by both such fine and imprisonment, in the discretion of the court, for each offense.

SEC. 9. The public good requiring the speedy enactment of this bill, the passage of the same is hereby expedited in accordance with section two of "An Act prescribing the order of procedure by the Commission in the enactment of laws," passed September twenty-sixth, nineteen hundred.

SEC. 10. This Act shall take effect on its passage.

Enacted, October 10, 1907.

COMMON DANGEROUS COMMUNICABLE DISEASES OF DOMESTIC ANIMALS IN THE PHILIPPINE ISLANDS.

By David G. Moberly.

RINDERPEST.

SUMMARY.

Some of the most important things to be remembered about rinderpest are the following:

Temporary immunity may be given to cattle or carabaos by the use of serum alone, and if rinderpest breaks out in a community all the herds of cattle and carabaos should be inoculated with serum as soon as possible in order to protect them. This can be done without any danger whatever. If rinderpest has actually broken out in a herd both the sick and the well animals should be inoculated with serum alone, and the well animals taken away from the sick ones as soon as possible. This will save many of the sick animals and prevent most of those which are well from contracting the disease. If it is desired to permanently protect cattle and carabaos against rinderpest and thus secure a number of animals that can always be depended upon, they should be inoculated by the simultaneous method. If this is done by a competent person, and if the animals are properly cared for while recovering from the inoculation, the losses will be very small and the owner will gain a very valuable herd which can not contract the disease. Before simultaneous inoculation is employed, however, the veterinarian or inoculator should satisfy himself that none of the animals to be inoculated are suffering from surra. If he finds surra in the herd, the simultaneous method should not be used.

Question 1. What is rinderpest?

Answer. It is a very contagious disease which attacks carabaos, cattle, and occasionally goats, hogs, and even wild deer.

Question 2. By what other names is this disease known?

Answer. In the Philippines and other Spanish colonies it is generally called epizoötia; in England and the English colonies cattle plague; on the continent of Europe and in many European colonies it is called rinderpest.

Question 3. In what countries did the disease formerly exist?

Answer. It has appeared many times in England, Germany, Russia, India, and parts of China.

Question 4. In what countries does it exist now?

Answer. South Africa, Egypt, India, China, and the Philippines.

Question 5. Has it always existed in the Philippines?

Answer. No. It seems to have come here between the years 1888 and 1892.

Question 6. How did rinderpest first get into the Philippine Islands?

Answer. It was probably first brought here by cattle coming from China and Indo-China, where rinderpest has existed for many years.

Question 7. Has it caused great damage here?

Answer. It has spread to nearly all of the islands and has killed many thousands of cattle and carabaos.

Question 8. Was the death of the animals the only loss?

Answer. No. The people could not prepare their lands, cultivate their crops, nor harvest and take them to market when they had no work animals.

Question 9. Is there much rinderpest in these Islands now?

Answer. There is not so much as in the year 1892, 1901, 1902, and 1903, but outbreaks are reported from time to time from different provinces, especially those near Manila.

Question 10. Is it possible to entirely free the Philippine Islands from rinderpest?

Answer. Yes. England and other European countries have sucessfully gotten rid of this disease a number of times, so that it has not appeared until brought in again.

Question 11. Is rinderpest being brought into the Philippines now?

Answer. Yes. More than 3,000 cattle and carabaos are imported from China and Indo-China monthly and in nearly every shipment from Hongkong and Hoihau, China, some animals are infected with rinderpest on arrival, or develop it within one to three days after arrival, showing that they were infected with the microbe of rinderpest before they left China.

Question 12. What causes the disease to occur from time to time in the different provinces?

Answer. The most common cause is the sale and shipment to the provinces of imported cattle. These cattle bring the infection into the Islands and spread it in corrals, on boats, and in cars, as well as along roads and around watering places. It is also spread just as easily by native cattle if they are infected or occupy infected corrals and boats.

Question 13. Is there any law to prevent the further introduction and spread of the disease in the Philippine Islands?

Answer. Yes. Act No. 1760 of the Philippine Commission; chapter 24 of the Sanitary Code (Ordinance No. 86) for the city of Manila; section 39, subsections (*m*) to (*s*), of Act No. 82 (Municipal Code);

and section 13, subsection (*k*), of Act No. 83 (Provincial Government Act).

Under these laws the Bureau of Agriculture, aided by the provincial and municipal authorities, can effectually suppress any outbreak that may occur.

Question 14. By what means might the infection be carried to the noninfected corrals from the infected ones?

Answer. There are many ways by which rinderpest germs may be carried from sick animals to healthy ones, even if the well animals are separated some distance from the sick ones: First, by the attendants or other persons carrying the infection on their feet when going direct from the infected corrals to the noninfected corrals; second, by using the same vessels for watering and feeding the well animals that have been used for watering and feeding the sick ones; third, by dogs, fowls, goats, or any other animals that are allowed to run at large around the premises, as these animals can carry infection on their feet and bodies from infected corrals.

Question 15. What is meant by the words "infected" and "noninfected?"

Answer. When an animal is suffering from a contagious disease it is said to be infected, when animals are well they are called noninfected animals.

Question 16. How long is it after being exposed before an animal takes the disease?

Answer. From three to eight days, the average being about six days. This is called the period of incubation.

Question 17. What percentage of cattle attacked by rinderpest die?

Answer. The percentage of loss may be 80, 90, or even 100 of all the animals in the herd which have not already had the disease and recovered from it. The percentage of deaths where the animals are not treated with serum is always very high.

Question 18. How can one know when his animals are suffering from rinderpest?

Answer. The more important and readily recognizable symptoms of rinderpest are as follows:

Symptoms: The first symptoms generally noticed in rinderpest are loss of appetite accompanied by fever, cessation of rumination, slight constipation which is followed by a watery diarrhea streaked with blood and mucous. The mucous membrane of the eyes is generally very red; often there is a foul discharge from the eyes and nose; the animal's back is generally arched; the tail is drawn down between the legs; the head is drooped and the ears hang loosely. When the disease is at its height the animal suffers from severe diarrhea. The discharge is of a bloody mucous consistency, and has a foul odor. The animal lies down most of the time, and saliva flows from the mouth. The

animal suffers from abdominal pains continually during the last few days of the disease. The skin usually becomes covered with scales around the flanks and sides and under the abdomen and inner surface of the thighs. The temperature runs from 39.5° C. to 41.5° C.

Question 19. Are other diseases commonly mistaken for rinderpest?

Answer. Yes. In the Philippines it is quite common to apply the name "epizoötia" to all contagious diseases which attack carabaos and cattle and even to those which attack horses.

Question 20. How can the introduction of rinderpest into the Islands be checked, without prohibiting the importation of cattle from China and Indo-China?

Answer. By placing the imported cattle from these countries in quarantine immediately on their arrival in a Philippine port, and keeping them in quarantine until absolutely sure that they are not infected with rinderpest.

Question 21. What is the first thing to do when carabaos or cattle become infected with rinderpest?

Answer. Separate the sick animals from the well ones and request at once the veterinarian or inspector in the district to come and inoculate the cattle with serum.

Question 22. In case there is no veterinarian or inspector, what is the first thing to do?

Answer. Notify the Bureau of Agriculture by telegram to send a veterinarian or inspector to treat your animals. In the meantime keep sick animals separated from the healthy ones and disinfect the corrals where the sick animals have been kept.

Question 23. When some of the animals show symptoms of rinderpest, should the sick animals be taken out of the corral and leave the well ones in the corral that is infected, or take the well ones out and leave the sick ones in the infected corral?

Answer. If rinderpest breaks out in a herd of cattle or carabaos where they are all corralled in one inclosure the healthy animals should be taken out of the infected corral and placed in new corrals that are at least 400 yards from the infected corral, and, if possible, the healthy animals should be divided into small herds and each small herd kept in a separate place.

Question 24. Why should the healthy animals be taken out of the infected corral instead of the sick, ones?

Answer. For the reason that in the great majority of cases where a herd of cattle is infected with rinderpest only a few of the animals are affected in the beginning of the outbreak; so, if the healthy animals are at once taken out when a few show symptoms of the disease, and placed in clean corrals not infected with the disease, they will escape the infection if they have not already been infected before they were removed from the corral that was infected.

Question 25. Why should the healthy animals be divided into small herds after they have been taken from the infected corral?

Answer. They should be divided into small herds for the reason stated above, that the period of incubation of rinderpest is generally about six days, and some of the animals though apparently healthy may already be infected and will develop the disease within a few days, and if they should be placed together in one corral they are all exposed again to the infection, so the disease may spread to several others of the herd before it could be detected. If placed in separate corrals only a few are exposed to the disease if it develops in only one corral, and there is a better chance to save the majority of the animals from getting the disease.

Question 26. After taking the healthy animals from the infected corral and placing them in clean corrals not infected, is there any danger of the new corrals becoming infected by transmission of the microbe from the infected corrals to the noninfected corrals?

Answer. Yes.

Question 27. How can the infection be prevented from spreading from the sick animals to the well ones after they have been properly separated?

Answer. To prevent the spread of the disease on a farm when one or more corrals are infected: First, the attendants who care for the sick animals should not be allowed to go near the healthy animals unless they first disinfect themselves thoroughly; the same rule applies to other persons who have been in the corrals where the sick animals are kept; second, the vessels used for feeding and watering the sick animals should not be used for feeding and watering the healthy animals, unless they are first thoroughly disinfected after having been used in the infected corral, it is best, however, to use different buckets or vessels for the sick and well animals; third, dogs, fowls, goats, and other animals should never be allowed to run at large on a farm when rinderpest is prevalent, different vehicles should be used for hauling food and water to the infected and noninfected corrals, in fact anything that has come in contact with infected corrals should not be allowed near healthy animals.

Question 28. What should be done to stamp out rinderpest on a farm when once the disease develops?

Answer. Separate the animals as stated above and thoroughly disinfect all infected corrals and stables, cremate or bury the carcasses of all animals that die of rinderpest.

Question 29. In what way are corrals to be desinfected and what agents are best suited for disinfecting open corrals and inclosed corrals or stables?

Answer. Corrals can be disinfected and rendered practically safe by complying with the following rules for disinfecting:

Open corrals are best disinfected by promptly burning all rubbish in the inclosure, such as leavings from the feed troughs and any litter of

any kind, especially hay, straw, manure, etc. Everything burned should be burned in the corral. The fencing should be gone over thoroughly with a solution of any of the standard germicides—namely, carbolic acid, 5 per cent solution; creolin, 5 per cent solution; or chloro-naphtholeum, 5 per cent solution. These solutions should either be sprayed over the surfaces to be disinfected or mixed with whitewash and applied with a whitewash brush. The latter method is more satisfactory for the reason that should any crevices or cracks in the surfaces disinfected be missed they will show when the wash becomes dry and can be gone over again. The ground in the corral, and a strip 20 meters or more wide outside the corral, should be covered over with common lime and then plowed under and the new plowed surfaces also covered over with lime. The surest way to stamp out the infection is to tear down the fencing and burn it on the infected ground instead of disinfecting it.

Covered corrals and stables can easily be disinfected by the use of any of the above solutions applied to the walls, mangers, and stalls in the same manner as prescribed for fences. All rubbish and manure in the stables should be burned.

All buckets or other vessels used in connection with the sick animals should be disinfected, and brooms should be burned.

Question 30. If dead animals can not be cremated, how deep should they be buried?

Answer. The hole they are placed in should be dug at least 2 meters deep.

Question 31. Why should the hole be dug 2 meters deep?

Answer. The hole should be dug 2 meters deep so that you can be sure that the buried carcass will have at least 1 meter of dirt over it.

Question 32. Why is it necessary to have the carcasses of animals dying of contagious diseases covered with 1 meter of dirt?

Answer. It prevents dogs from uncovering the carcass and carrying infection to other animals.

Question 33. How can dogs carry the infection?

Answer. The dogs can carry the infection on their feet, mouths, and any other part of their bodies that comes in contact with the diseased carcass.

Question 34. How long will the germ of rinderpest live and retain virulency in pastures or corrals where carabaos and cattle having rinderpest have been kept?

Answer. The germ of rinderpest will remain virulent in the ground from two to twelve months, depending on the season and kind of soil in the pasture. It remains virulent much longer in swampy ground than in high and dry land.

Question 35. Can animals actually suffering from rinderpest be cured?

Answer. They can be cured in 60 to 70 per cent of the cases by the

use of antirinderpest serum, if the serum is given when the first symptoms of the disease appear.

Question 36. May serum alone be safely administered by an inexperienced person?

Answer. Yes; since serum itself is perfectly harmless.

Question 37. How is the serum made?

Answer. Antirinderpest serum is made in the following manner: A small quantity of blood from an animal sick of rinderpest is injected into an animal which is immune to the disease. This does not cause an attack of rinderpest, as would be the case if such blood were injected into a nonimmune animal, but produces a very slight fever. When this fever is at its height, blood is drawn from the animal and the solid part of the blood is separated from the fluid part of the blood, otherwise known as serum. This serum is then properly treated so that it will keep for some time.

Question 38. How long will the serum keep without deteriorating?

Answer. About six months, if kept in a cool place, and much longer if kept on ice.

Question 39. How is serum used?

Answer. It is injected by means of a hypodermic syringe under the skin of the animal to be treated.

Question 40. Is its use attended with any danger?

Answer. No. This serum is absolutely harmless and it can be used without any danger.

Question 41. Has this serum any value apart from its power to cure animals sick of rinderpest?

Answer. Yes; when injected into well animals, it makes them temporarily immune to rinderpest in the majority of cases and if the animals do take the disease within a few weeks after being inoculated it is generally of a mild form, easily cured.

Question 42. How long after the administration of the serum is this immunity established?

Answer. In from two to five days.

Question 43. How long does this temporary immunity last?

Answer. From one to two months.

Question. 44. Does it entirely disappear at the end of two months?

Answer. No. It has been observed that even after this period has passed, animals which have been inoculated with serum, while they may contract rinderpest, are much more likely to recover than those which have never received serum inoculation.

Question 45. What, then, are the uses of this serum?

Answer. First, its use in curing animals sick of rinderpest; second, its use in conferring temporary immunity upon animals which have been or are likely to be exposed to the disease.

Question 46. Should it be used on animals in a herd in which rinderpest has broken out?

Answer. Yes. Many of the animals already diseased can be saved by its use, and most of those which have not contracted the disease may be temporarily protected against it until danger of infection has passed.

Question 47. May an animal which has suffered from rinderpest and recovered again contract the disease?

Answer. No. Such an animal is immune to the disease.

Question 48. Is there any other way in which sound animals may be rendered permanently immune to rinderpest?

Answer. Yes. They may be permanently immunized by the "simultaneous," "double," or "mixed" inoculation.

Question 49. Do the animals inoculated by the simultaneous method get sick?

Answer. The more susceptible among them get quite sick and need careful attention. It is often necessary to repeat the dose of serum with such animals. The less susceptible do not get very sick.

Question 50. Do animals need special care while undergoing simultaneous inoculation, or may they be left without attention?

Answer. They need special care. They should be well fed, and it is especially important that they should be abundantly supplied with good drinking water. Their temperatures should be taken at frequent intervals, and if found too high, additional serum should be given to them.

Question 51. Is it safe for an inexperienced person to inoculate animals by the simultaneous method?

Answer. No. Inoculation by the simultaneous method should be performed only by a veterinarian or a well-trained inoculator.

Question 52. What is meant by "simultaneous," "double," or "mixed" inoculation?

Answer. This method consists in giving a sound animal a hypodermic dose of blood on one side, and at the same time a dose of serum on the other side. In other words, it consists in giving the animal the disease and the remedy for it at the same time.

Question 53. Is there as much danger that the animals so treated will die as there is that an animal already sick of rinderpest inoculated with serum will die?

Answer. No. In the latter the disease in most cases is already well established before the remedy is given. In the first case the remedy is given before the disease has had time to develop, so that the danger is much less.

Question 54. What percentage of sound animals which are given simultaneous inoculation die?

Answer. Under favorable conditions, such as exist at the serum laboratory and at the inoculation stations of the Bureau of Agriculture,

very few die. Under such circumstances large numbers of animals have been inoculated by the simultaneous method without any loss whatever, and the loss seldom exceeds 5 or 6 per cent of the number inoculated.

Question 55. May any complications arise in connection with simultaneous inoculation?

Answer. Yes. Surra is one of the serious complications met with in connection with the simultaneous inoculation.

Question 56. What is surra?

Answer. Surra is a very contagious disease which attacks horses, mules, jackasses, and cattle.

Question 57. Is it a fatal disease?

Answer. Yes. It is always fatal to horses, mules, and jackasses, but it is not necessarily fatal to carabaos and cattle. When such animals once contract it, however, they seldom get entirely rid of it. It does not kill them promptly as it does horses, but becomes chronic and they suffer from it from time to time just as men suffer from malaria, and if horses, mules, or jackasses come in contact with carabaos or cattle having surra they may contract the disease and die.

Question 58. What complications does surra cause in connection with inoculation by the simultaneous method against rinderpest?

Answer. If carabaos or cattle are given simultaneous inoculation while suffering from surra about half of them will die.

Question 59. How may such an accident be avoided?

Answer. If surra is known to exist in any locality, the blood of all animals to be inoculated should be examined microscopically. Surra is caused by a minute organism which swims in the blood of the animals attacked by this disease. This small organism can readily be seen with the microscope.

Question 60. What can be done for carabaos and cattle suffering from surra when they are threatened with rinderpest?

Answer. The only thing that can safely be done is to give them serum inoculation.

Question 61. Is there any danger connected with the administering of serum alone to carabaos or cattle suffering from surra?

Answer. No. There is no danger whatever.

Question 62. Why should animals be inoculated by the simultaneous method and run the risk of losing some of them when they can be temporarily immunized by the use of serum alone without any danger of loss?

Answer. Because in the latter case you will get only temporary protection. Rinderpest may break out again in the vicinity after the animals have lost their temporary immunity and many of them may die before you can secure assistance; while animals successfully inoculated by the simultaneous method will never afterwards contract rinderpest.

Question 63. How can immune animals be had by those who desire to purchase them?

Answer. Immune animals are sold by the Bureau of Agriculture from the serum laboratory, but, as the supply of such animals is limited, the surest way is to buy the cattle and have them inoculated by the Bureau of Agriculture.

Question 64. How may one who desires to buy such animals be assured that they are already immune?

Answer. By securing with each animal a certificate issued by the Bureau of Agriculture stating that they have been immunized, or by securing reliable information that they have had rinderpest and recovered.

Question 65. Is there a serious risk in buying imported cattle for work purposes without having them inoculated?

Answer. Yes; but the risk is greatly decreased if the cattle have undergone quarantine at the port of entry, have been inoculated with serum or are accompanied by a certificate issued by the Bureau of Agriculture stating that they were free from rinderpest when they were shipped and are sent on clean boats and cars and are not exposed to rinderpest.

Question 66. What other precaution may be taken to avoid losses among cattle purchased and those on a farm where new cattle are being introduced?

Answer. Do not buy native cattle from infected islands or provinces, or animals that have been exposed to the disease. Do not mix new cattle for at least ten days after they arrive with the cattle already on the farm. If the new animals are not accustomed to hard work break them in slowly so as not to weaken them.

SURRA.

Question 1. What is surra?

Answer. Surra is a contagious febrile disease which attacks horses, carabaos, cattle, and occasionally other animals, such as dogs, cats, deer, and goats. It is generally known as a disease affecting horses and mules, because it always kills them, while carabaos and cattle may give little evidence of sickness while suffering from it, and may ultimately recover.

Question 2. By what other name is surra known?

Answer. In this country it is sometime called pernicious anemia and epizoötia of the horse.

Question 3. In what countries does this disease now exist?

Answer. In India, South Africa, and the Philippine Islands.

Question 4. When was surra introduced into the Philippine Islands?

Answer. In the year 1901.

Question 5. How?

Answer. By the importation of race horses from India.

Question 6. To what extent does surra prevail in these Islands?

Answer. It is present in a few of the provinces, but the outbreaks are not serious or extensive.

Question 7. Has surra caused much damage in the Philippines since its introduction?

Answer. Yes; it has killed more than 80 per cent of all the horses and mules in this country.

Question 8. Is it possible to eradicate surra from the Philippine Islands?

Answer. Yes; but it is much more difficult to eradicate than rinderpest.

Question 9. Why is surra so difficult to eradicate?

Answer. Because the organism of surra may live in the blood of carabaos, cattle, wild deer, and wild hogs for many months, or even years, without causing them any great inconvenience or the development of any noticeable symptons. At the same time the affected animals are a constant source of infection from which horses and mules may contract the disease and die.

Question 10. Have other countries got rid of surra?

Answer. No country where surra has once existed has ever entirely got rid of it. In the Philippine Islands the Bureau of Health and the Bureau of Agriculture have held it in check and have stamped it out in many provinces.

Question 11. What percentage of carabaos and cattle die of surra?

Answer. According to experience in the Philippines a small percentage of the carabaos and cattle infected with surra die, so long as kept under favorable conditions. However, if carabaos and cattle that have surra are crowded closely together or become sick with any other disease that causes fever, they will generally die, though the other disease alone might not be fatal.

Question 12. What common diseases not necessarily fatal to carabaos and cattle, if properly treated, would cause the death of animals having surra?

Answer. Foot-and-mouth disease, inflammation of the stomach, or indigestion, mild cases of rinderpest, and simple fevers.

Question 13. What other complications should be avoided?

Answer. Simultaneous inoculation for permanently immunizing cattle and carabaos against rinderpest, overwork and insufficient food, excessive heat, and other conditions which tend to weaken the animals and lessen their ability to withstand the influence of surra.

Question 14. What causes surra?

Answer. Surra is caused by a microscopic organism in the blood.

Question 15. How does this organism get into the blood?

Answer. It enters the blood through wounds on the skin or in the mouth and by fly bites.

Question 16. How may fly bites cause surra?

Answer. Flies that have been biting animals infected with surra, or feeding on open wounds, will carry the organism on their feet, bodies, or mouths from the sick animals. If these flies light on wounds of other animals they will leave the organism in the wounds. If they bite other animals they will deposit the organism directly in the blood. In either case it will multiply and cause the disease.

Question 17. What are the most common symptoms of surra?

Answer. The symptoms of surra develop gradually. The animal first becomes somewhat dull and listless, does not seem to relish its food, and easily becomes exhausted on exertion. The hair is rough in appearance, the skin becomes dry and hot, and fever is present. The fever is remittent or relapsing; that is, the temperature is high for a few days and then falls to the normal, when the animal will improve for a while. In a few days the temperature will rise again and the symptoms are more pronounced than in the first attack. This condition of rise and fall of temperature continues, leaving the animal much weaker, and the general condition more aggravated at the end of each period of fever, until it can no longer stand on its feet. In many cases the animal then soon dies, while in other cases it suffers from severe intestinal pains and may live several days, or even a week, after it is unable to rise. The animal continually struggles, pounding its head on the ground until it is bruised and swollen, wearing the hair off that part of the skin which comes in contact with the ground. Often the skin is worn through and large abscesses are formed. From the beginning of the fever until death the animal grows thin rapidly. In the advanced stages of the disease large swellings may appear on the hind legs and these swellings often extend along the abdomen. Swellings caused by surra are different from simple swellings, in that the edges are clearly defined. They have the appearance of caked masses, are soft to the touch, and a pit made by pressure tends to remain. When fever is present the animal shows great thirst and at times a ravenous appetite.

Question 18. Can surra be cured?

Answer. In horses, mules, or jackasses it is incurable.

Question 19. What should be done with animals found to be suffering from surra?

Answer. If cattle, they should be isolated and pastured or worked on a separate part of the farm, so as to avoid further spreading the disease to horses and cattle. If horses, mules, or asses, they should be killed immediately and cremated or buried at least one meter deep, so as to prevent the disease being spread by dogs, birds, and insects.

FOOT-AND-MOUTH DISEASE.

Question 1. What is foot-and-mouth disease?

Answer. Foot-and-mouth disease is a contagious disease of carabaos, cattle, goats, sheep, and swine. Man can become infected by drinking milk of infected animals.

Question 2. Is this disease as fatal to carabaos and cattle as rinderpest?

Answer. No. Foot-and-mouth disease yields readily to treatment, if such treatment is applied at the beginning of the disease; but if not properly treated a large percentage of the sick animals may die, especially in the rainy season.

Question 3. By what other name is this disease known?

Answer. In Europe it is generally called "aphthous;" in the Philippines it is known as "glosopeda."

Question 4. Is this disease highly contagious?

Answer. Yes.

Question 5. What is the history of foot-and-mouth disease?

Answer. For the last fifty years this disease has been known to exist in some parts of Europe. In later years it has appeared at various times in both North and South America, China, and the Philippine Islands.

Question 6. What causes foot-and-mouth disease?

Answer. While this disease is known to be highly contagious, the microbe is not positively known.

Question 7. What are the symptoms of foot-and-mouth disease?

Answer. The first symptoms generally are as follows: A slight loss of appetite, dryness of the muzzle, a slight rise of temperature, and a disposition of the animal to be easily excited. The mouth is hot and tender, frothy saliva, having a characteristic offensive smell, flows from the mouth, a smacking sound is made with the tongue against the roof of the mouth, the appetite gradually decreases, the feet become tender and the animal very lame. From the second to the third day small eruptions appear on the inside of the lips. These eruptions break down in their centers, leaving open ulcers which spread in size until several are joined together in one large ulcer, sometimes an inch in diameter and having a bloody surface. The saliva is increased and is mixed with blood. At the same time that the eruptions appear in the mouth, small eruptions appear in the crevices (interdigital spaces) of the feet and, in females, on the teats. These eruptions develop in about the same manner as those in the mouth, but are smaller. If the case is not treated, the ulcerations of the feet continue to spread, causing the hoofs to come loose and sometimes drop off. In such cases death generally occurs. The temperature may rise to 40° C. on the fourth or fifth day of the disease.

Question 8. What is the treatment of foot-and-mouth disease?

Answer. The sick animals should first be placed in a clean, dry place (if in the rainy season under shelter). Cleanse the feet, udder, and teats thoroughly every day with a 5 per cent solution of carbolic acid, using soap, and then with a piece of cotton or gauze wrapped on a stick apply pure creolin to the ulcers or sore places. Place a small piece of cotton between the crevices of the feet, and bandage the feet with pieces of burlap (common sacking), which have been soaked in a 5 per cent solution of carbolic acid or creolin and dried. The mouth should be cleansed three or four times daily with a saturated solution of boracic acid, but if the ulcers do not begin to heal within a week's time, they should be slightly cauterized with nitrate of silver. The healthy animals of the herd should not be allowed to come near the sick ones, and should have different attendants. The corrals of both the sick and healthy animals should be disinfected daily.

Question 9. How can the disease spread from one hacienda to another?

Answer. This disease can spread the same as rinderpest and other contagious diseases of domestic animals, by healthy animals coming in contact with those that are infected, or by the infection being carried on the feet of persons, dogs, hogs, and other animals.

Question 10. How can the disease be prevented from spreading?

Answer. By using strict quarantine measures, and by preventing any animals from leaving an infected farm until the disease is entirely eradicated.

Question 11. What is the duration of foot-and-mouth disease?

Answer. From twelve to fifteen days.

Question 12. Should the milk from animals suffering from foot-and-mouth disease be used?

Answer. No. The milk should not be used for any purpose, as such milk will convey the disease to children or animals drinking it.

ANTHRAX.

Question 1. What is anthrax?

Answer. Anthrax is an acute contagious disease which attacks all animals, including man.

Question 2. By what other name is anthrax known?

Answer. In England anthrax is called splenic fever and infectious enteritis. The Spanish names for this disease are "pústula maligna" and "mal del bazo."

Question 3. What is the history of anthrax?

Answer. Anthrax is one of the oldest known infectious diseases; its history dates back for more than four centuries.

Question 4. In what countries has anthrax prevailed in the past centuries?

Answer. Anthrax has prevailed at different times in every civilized country in the world; it continues to appear from time to time in nearly every country.

Question 5. Is anthrax now, or has it ever been, present in the Philippine Islands?

Answer. Yes. Anthrax has appeared at many different times in the northern provinces of Luzon.

Question 6. How did the Philippines become infected with anthrax?

Answer. The disease was probably introduced here by cattle coming from China, or by sheep and goats brought here from Spain.

Question 7. Is it difficult to eradicate anthrax when it has once been introduced into a country?

Answer. Yes. Anthrax is the most difficult of all known infectious diseases to eradicate when it has once been introduced.

Question 8. Is it difficult to prevent anthrax from entering the Philippine Islands?

Answer. No.

Question 9. How can the further introduction of this disease be prevented when cattle are being brought in continually from other countries?

Answer. The further introduction of anthrax can be prevented by a close inspection of all animals aboard ship before they are allowed to land, and by placing all imported animals in quarantine for ten or fifteen days before they are shipped to the provinces.

Question 10. What causes anthrax?

Answer. Anthrax is caused by a germ which can only be seen under a microscope. The germ is called *Bacterium anthracis.*

Question 11. What are the principal symptoms of anthrax?

Answer. The symptoms of anthrax are varied. They may appear suddenly, and the animal be found dead before the owner has any knowledge that it is sick. The sick animal has convulsions; sudden swellings with well-defined borders appear in various places on the surface of the body, the animal staggers, utters sounds of agony, and may drop dead in a few minutes after the first symptoms are noticed. In the less acute form of the disease the sick animal loses its appetite and has severe abdominal pains accompanied by diarrhea, the coat becomes roughened, and often blood oozes from the eyes, nose, and mouth. As the disease advances, these symptoms become more violent and the animal dies suddenly in convulsions.

Question 12. Are there any peculiarities about the carcass of an animal that has died of anthrax?

Answer. Yes. The carcass of an animal that has died of anthrax swells, or bloats, shortly after death.

Question 13. Is it safe for an unqualified person to hold post-mortem on an animal that has died of a disease supposed to be anthrax.

Answer. No. A veterinarian should be called at once to examine the carcass. If no veterinarian can be had, the nearest physician should be called, as the disease is dangerous to man.

Question 14. What should be done with the carcass of an animal that has died of anthrax?

Answer. The carcass should be burned, as burying does not destroy the germs of anthrax. These germs have been known to live twelve years under ground and then appear on the surface, infect animals, and cause a fresh outbreak of the disease.

Question 15. Is there any cure for anthrax?

Answer. No. Anthrax is treated by preventing the disease rather than by attempting to cure the sick animals. This treatment consists in injecting under the skin a substance which is generally known as anthrax virus. This virus contains anthrax germs weakened to a state where they can not cause the death of the animal treated. The injecting of this anthrax virus causes a slight elevation of temperature, and renders the animal partially immune. When the temperature is again normal, a stronger virus is injected and the animal is then considered to be immune.

Question 16. What is the first thing to be done when anthrax breaks out in a community?

Answer. A telegram should be sent immediately to the Bureau of Agriculture in Manila, requesting that a veterinarian be sent at once, and stating that the disease is supposed to be anthrax. All of the infected area should be placed in quarantine, and no animals should be allowed to pass either in or out of the quarantined district. All dead animals should be burned, and all healthy animals separated from those that are sick.

Question 17. What percentage of animals that have anthrax die?

Answer. If the disease is of the form first described in Question 11, usually about 100 per cent die, and if it is the intestinal form, from 80 to 100 per cent die.

HOG CHOLERA.

Question 1. What is hog cholera?

Answer. Hog cholera is a very highly contagious disease affecting swine.

Question 2. Does hog cholera exist in the Philippine Islands?

Answer. Yes. The disease has been found in every part of the Archipelago where hogs are raised.

Question 3. Is the disease of much importance here?

Answer. Yes. The loss sustained by this country through the death of swine by cholera amounts to many thousand pesos annually.

Question 4. Do all swine affected with cholera manifest nearly the same symptoms?

Answer. No. Many of the symptoms presented in different outbreaks

and among different swine in the same outbreak are entirely different. This fact has led many veterinarians who have studied the disease to divide it into three forms.

Question 5. What are these three forms?

Answer. First, the septicemic form, which kills very quickly, and causes but little change in the tissues; second, the pulmonary form, known as swine plague, in which the principal changes are found in the lungs; and third, the intestinal form, usually spoken of as swine fever or hog cholera proper.

Question 6. Are all these forms of the disease ever present in the same herd of swine?

Answer. Yes; but usually they are not very distinct.

Question 7. What are the symptoms presented by hog cholera?

Answer. In the acute, or septicemic form, the animal, without showing any previous symptoms, suddenly ceases to eat and becomes dull. Soon a very high fever is present, accompanied by rapid and labored breathing. Blood and mucus may pass from the nostrils. The animal vomits, staggers, and falls down. Death usually takes place in from three to ten hours from the time the first symptoms are noticed. In the pulmonary and intestinal forms, which are less acute than the septicemic form spoken of above, the animals affected gradually lose their appetite and become depressed and weak. The back is arched, the head lowered, and a short, painful cough is present. There is a moderate fever; a thin, watery discharge from the eyes and nose which later changes into a thick, sticky semifluid substance, which upon drying often completely closes the eyes; the breathing is rapid and of a pumping, panting character. The mucous membranes about the eyes, nose, and mouth change to a dull, dirty blue, and red blotches appear on the skin, covering the underside of the body, the inner side of the limbs, and the area close behind the ears. The eyes are sunken, of a lead color, and often show irregular, reddish lines representing enlarged blood vessels. The animal is constipated during the first stages of the attack, but soon a characteristic greenish, ill-smelling diarrhea sets in. Death takes place in from three to ten days.

Question 8. If an animal that died from the effects of the septicemic form of hog cholera be opened, what changes from the normal would be noted?

Answer. In many instances no alterations can be seen without the aid of a microscope. In some cases on the membranes lining the thoracic and abdominal cavities small red spots can be seen. These red blotches might also be noticed just under the skin on some parts of the body, in the walls of the intestines, in the substance of the kidneys, and in the lymphatic glands.

Question 9. What changes in the tissues are found upon opening an animal dead from the effects of the less acute forms of the disease?

Answer. The changes mentioned above are present, and in addition the spleen is enlarged, soft, and dark colored. Portions of the lungs may be very dark, nearly black in color, and upon cutting into these areas a bloody fluid mixed with pus is found. The mucous membrane lining of the stomach and intestines is much inflamed and reddened. In the lower portions of the small intestines, in the cæcum, and in the large intestines numerous ulcers are found. These ulcers, which vary in size from one-eighth of an inch to 2 inches in diameter, project above the surface of the mucous membrane, are irregular in outline, and have a yellowish, black color. All the changes described above are not always found in every case examined.

Question 10. What then is the most important thing to look for in deciding whether the animal has died of hog cholera?

Answer. The ulcers in the intestines, for if the animal has died with cholera (other than the acute form) the ulcers will always be present to a greater or less extent.

Question 11. What should be done when swine commence to die of a disease supposed to be hog cholera?

Answer. The sick swine should be killed and burned. The well ones should be removed from the place where the sick ones were running, and should be divided into small lots and confined. They should be observed closely and if any show the least indications of not being well they should be removed from the rest. Each day all swine should be dipped in a 2 per cent solution of creolin, or some other similiar disinfectant. If the facilities for dipping them are not at hand, they may be sprayed or washed with the same solution. The lots and sheds where the swine are kept should also be sprayed or sprinkled daily with a disinfectant. Healthy swine should not be allowed on grounds or in buildings where sick hogs have been until these grounds and buildings have been thoroughly disinfected. Often where the infected area is so large that it is impracticable to apply disinfectants it may be plowed and cropped, which will destroy all cholera infection the soil may contain.

Question 12. How long after hogs are exposed to hog cholera do they commence to show the first symptoms of the disease?

Answer. From seven to fourteen days.

Question 13. In an outbreak of hog cholera what percentage of the swine attacked by the disease recover?

Answer. About 5 per cent.

Question 14. How is hog cholera brought from one section of the country to another?

Answer. In most cases by sick animals being transported from one district into or through another.

Question 15. How is a noninfected herd of swine usually infected?

Answer. In the majority of cases this is brought about by an animal

which has been exposed to the disease being purchased at some place more or less distant and immediately turned among the noninfected swine. In a few days the newly purchased animal is stricken with cholera and infects the whole herd. In some cases a stray or wild hog contracts the disease and in its wanderings infects all the swine in that section of the country. Infective material may be brought to the herd by carts or other conveyances which have passed through an infected district, or by carts which have been used to transport sick swine. The infection may also be carried to the herd on the feet of men, dogs, or other animals. Birds often carry the infection a long way.

Question 16. How may birds carry the infection of hog cholera?

Answer. By carrying small pieces of flesh torn from carcasses of swine dead of hog cholera and dropping this flesh where healthy swine will find and devour it.

Question 17. How should a healthy herd of swine be managed so that they may be kept free from hog cholera, even though this disease be present in the locality?

Answer. They should be confined by a double fence to protect them from diseased hogs without. No swine that have not been held in quarantine for at least four weeks, and found to be healthy at the end of that time, should be placed with the well ones. The caretakers of the healthy herd should not assist in the care of any other swine. Nothing should be taken into the inclosure where the hogs are kept that has been in contact with sick swine, or in an infected district. Isolate any animals that show the slightest symptoms of disease.

Question 18. Is there any cure for hog cholera?

Answer. No.

GLANDERS.

Question 1. What is glanders?

Answer. Glanders is a contagious disease affecting horses, mules, asses, and occasionally man.

Question 2. What is the history of glanders?

Answer. Glanders is one of the oldest contagious diseases affecting domestic animals. Its history dates back to before the beginning of the Christian era.

Question 3. In what countries does this disease now exist?

Answer. Glanders exists at the present time in nearly every country in the world.

Question 4. Is glanders now prevalent in the Philippine Islands?

Answer. Yes. Glanders is now prevalent in the Philippine Islands and has existed here for many years.

Question 5. Is this disease widely distributed in the Philippines?

Answer. Yes. Glanders is to be found in nearly every municipality in the Islands.

Question 6. Has glanders, like surra and rinderpest, caused much damage in the Philippine Islands?

Answer. Yes. Glanders has caused great destruction of horses and hundreds are now being killed by this disease.

Question 7. Does glanders spread as rapidly as other diseases?

Answer. No. It is not so highly contagious as surra and rinderpest.

Question 8. Can this disease be cured?

Answer. No.

Question 9. How long do animals suffering from glanders live?

Answer. There are two types of glanders called acute and chronic. In acute glanders the animals live from one to six weeks. With chronic glanders a horse may live many months.

Question 10. What is the cause of glanders?

Answer. Glanders is caused by an extremely small microbe called *Bacterium mallei.*

Question 11. Are acute glanders and chronic glanders caused by the same microbe?

Answer. Yes.

Question 12. Why do horses suffering from acute glanders die so soon when those suffering from chronic glanders live much longer?

Answer. After the first acute fever, which is always the beginning of glanders and is the most virulent period of the disease, the disease becomes chronic. Some animals can withstand this acute fever and others can not.

Question 13. What are the principal symptoms of glanders?

Answer. The symptoms of glanders are as follows: At first a slight sticky discharge is noticed from one or both nostrils. This discharge soon becomes a greenish yellow pus, which emits a foul odor. At this period, on examination of the mucous membrane (the lining of the inside of the nostril) little ulcers of various sizes from that of a pinhead to that of a 10-cent piece will be found. The edges of these ulcers are rough and irregular in outline. Under the throat the glands are swollen and painful to the touch. The animal becomes easily exhausted on exertion and at the height of the fever, which is about 40° C., the hair of the mane and tail is loose and easily pulled out. In some cases the throat and lungs are attacked and a severe cough accompanies the disease. When the lungs are affected the animal usually lives but a short time. In some cases glanders affects the superficial lymphatic glands, causing small lumps or nodules. The skin breaks down over the center of these lumps, and they develop into open wounds, or ulcers, discharging a thick greenish-yellow pus. This form of the disease is called "farcy" or "cutaneous glanders."

Question 14. Are there other diseases that might be mistaken for glanders?

Answer. Yes. Ulcerative lymphangitis is often mistaken for glanders, and vice versa.

Question 15. In what way does lymphangitis resemble glanders?

Answer. Lymphangitis resembles glanders in that it affects the superficial lymphatic glands, causing open ulcers or boils along the line of the lymphatic veins.

Question 16. How is glanders to be distinguished from lymphangitis?

Answer. When doubt exists as to what the disease is, a veterinarian should be called to make a microscopic examination or mallein test.

Question 17. Are there any other diseases that resemble glanders?

Answer. Inflammation of the throat, trachea, or lungs, causing a discharge from the nostrils, might be mistaken for glanders. In these affections, however, there will be an absence of ulcers in the nose, and the mallein test if applied will not give a reaction.

Question. 18. What disposition should be made of animals suffering from glanders?

Answer. They should be destroyed immediately, and the carcasses either deeply buried or burned. The premises where the sick animals have been kept should be thoroughly disinfected or burned. All horses that have been in contact with the diseased animals should be closely observed for a month or more to determine if any have become infected. The disinfectants prescribed for other diseases will destroy the germ of glanders.

HEMORRHAGIC SEPTICEMIA.

Question 1. What is hemorrhagic septicemia?

Answer. Hemorrhagic septicemia is an acute contagious disease which may attack nearly all kinds of domestic animals.

Question 2. What causes hemorrhagic septicemia?

Answer. This disease is caused by a very small egg-shaped germ, which is found in the blood and tissues of the animal affected.

Question 3. Is this disease as widespread as the other diseases mentioned in this series?

Answer. No. Hemorrhagic septicemia has appeared from time to time during the past century in some of the countries of Europe, and during the last few years in the United States. This disease was discovered in Manila in 1903, and in the Provinces of Occidental Negros and Bulacan in 1904 and 1905. It is not known whether or not it existed here before American occupation.

Question 4. Is this disease as fatal as surra, rinderpest, or anthrax?

Answer. Yes. Its course is as rapid, if not more so, than that of anthrax. In some cases animals which are apparently healthy will turn around once or twice and drop dead; or, if tied by a halter, will apparently try to break loose from their manger and drop dead. Many

animals, found dead in the pasture or stable, reveal this disease on microscopical examination.

Question 5. What are the symptoms of hemorrhagic septicemia?

Answer. When the disease runs a longer course than that described above, the sick animal will suddenly stop eating, the pulse becomes rapid, the temperature rapidly rises to 40° C., the muzzle is dry and hot, the hair looks rough, the mucous membrane of the mouth, nose, and eyes shows a deep red color, and, if the course is longer than a few hours, small hemorrhagic blotches appear on the surface of the mucous membrane lining the nostrils, this membrane being of blue or purple color. Under the throat and between the lower jaws a large, hot, painful swelling appears, which sometimes extends down the neck to the breast. In some cases this swelling is from 4 to 6 inches thick. The breathing becomes very difficult and sometimes the animal chokes to death from the pressure of this swelling on the throat. The mouth is filled with dry, stringy saliva, and the tongue hangs out. Some cases, even in this condition, have been known to last from one to four days, developing symptoms of pneumonia and intestinal disturbances, and often having violent intestinal pains. The sick animal trembles from the beginning of the disease and often has muscular convulsions. Sometimes the feces are hard and covered with a thick coating of mucus streaked with blood, while in other cases there is a severe watery diarrhea mixed with blood.

Question 6. Is hemorrhagic septicemia curable?

Answer. No. No effective cure for this disease has yet been discovered. Scientists are now working on a serum treatment which is hoped will be successful in preventing the disease.

Question 7. What should be done when a herd of animals is attacked with this disease?

Answer. The sick animals should be isolated and removed to a high, dry place. All the healthy animals should be removed from the place that is infected, and precautions should be taken to prevent the spread of the disease to other localities. If the infection comes from a corral or stable, these premises should be disinfected at once with any of the disinfectants that have been recommended for other diseases. If the stable is dark and damp, burning is recommended, as the germ of hemorrhagic septicemia can live only in damp places, and is readily destroyed by drying. In open ground, if it is not damp, this germ is destroyed by sunshine.

Question 8. What is the percentage of loss from hemorrhagic septicemia?

Answer. The loss in this country, so far as is now known, has been close to 100 per cent. In countries that are high and dry the mortality among cattle and sheep has been from 50 to 80 per cent.

ULCERATIVE LYMPHANGITIS.

Question 1. What is lymphangitis?

Answer. Lymphangitis is a contagious disease affecting horses and cattle, more commonly horses.

Question 2. In what countries does lymphangitis exist?

Answer. This disease exists principally in the Far East, including the Philippine Islands.

Question 3. What part of the body is affected by this disease?

Answer. Lymphangitis affects the lymphatic glands and lymphatic veins.

Question 4. Is this disease very contagious?

Answer. No; it is not as contagious as surra and rinderpest.

Question 5. Is this disease widely distributed in the Philippines?

Answer. Yes. This disease is present in nearly every province in the Islands.

Question 6. Has lymphangitis caused much damage in the Philippine Islands?

Answer. Yes; it has caused considerable damage to the horse industry, but very few cattle have been affected.

Question 7. Is this disease curable?

Answer. Yes; although the duration of lymphangitis is from two to twelve months, it will yield to treatment.

Question 8. What is the mortality caused by this disease?

Answer. When lymphangitis receives proper treatment the mortality is very low.

Question 9. What are the most damaging effects of this disease?

Answer. The most serious loss caused by lymphangitis is the long duration of the disease during which time, in many instances, the animal can not be used for labor.

Question 10. What causes lymphangitis?

Answer. This disease is caused by a small, round germ, which can only be seen with the aid of a microscope.

Question 11. What are the symptoms of lymphangitis?

Answer. Ulcerative lymphangitis appears along the course of the lymphatic veins in the form of small nodules or lumps, which, in the beginning, are hard and sensitive to the touch. In some cases only one or two of these lumps are found, generally along the point of the shoulder or the side, back of the elbow, or around the face. These lumps gradually enlarge from the size of a pea to that of a small hen egg. They break down in the center, forming ulcers similar to those of farcy or cutaneous glanders, and discharge a glossy, yellowish pus that resembles jelly. The microbe is carried from one point to another throughout the body, new patches of nodules appear from time to time, and unless treatment is applied early, nearly the entire skin may become covered with these

nodules and ulcers. In severe cases the animal rapidly becomes emaciated and unable to perform labor.

Question 12. What other diseases may be mistaken for lymphangitis?

Answer. Farcy or cutaneous glanders is often mistaken for lymphangitis; also, tropical ulcers and bursatti.

Question 13. How may lymphangitis be distinguished from these diseases?

Answer. In farcy, as a rule, the nodules are not so numerous as in lymphangitis. The pus discharged from nodules in farcy is of a greenish hue, is generally streaked with blood, and has an offensive odor. In doubtful cases the mallein tests will establish a diagnosis. Tropical ulcers may appear on any part of the body and do not follow the lymphatic veins; generally the surface of the ulcers is raw, and as a rule the nodules are few in number and very large in size, sometimes being 2 inches in diameter. Bursatti closely resembles tropical ulcers, and causes considerable sloughing of the tissue of the parts infected. Like tropical ulcers, it does not follow the lymphatic veins.

Question 14. What is the treatment for lymphangitis?

Answer. When the nodules first appear and are only few in number they are often reduced by blistering, over the area affected, with a preparation of mercury and cantharides in the portions of 2 parts red iodide of mercury and 4 parts of cantharides, mixed with 15 parts of vaseline. Clip the hair over the surface of the nodules and 4 to 5 inches wide along their course; brush the surface well with a dry brush and then with the fingers apply the paste over the surface, rubbing it for at least ten minutes; tie the horse so that he can not reach the blister with his mouth, allow the blister to remain from two to twelve hours, after which the part where it was applied should be washed with warm water and soap to remove the blistering material. This treatment should be repeated within a week if the nodules do not disappear. In case the nodules have already developed into ulcers and filled with pus, open them with a knife and scrape all the contents out; thoroughly cleanse the wounds with a 5 per cent solution of carbolic acid or creolin, and fill the places with salol or iodoform. This dressing should be applied each day. When the ulcers have broken down and the disease is in the advanced stage on some parts of the body, while on other parts it is just developing, both remedies can be applied at the same time, as this disease is one that requires constant and stringent treatment. Internal treatment is not often of much benefit, though a saturated solution of potassium iodide, one-half ounce in a pint of water, may be given twice daily. This treatment should not be continued for more than four or five days at a time. It should then be stopped for the same period, and may be continued for another period of four or five days, but should not be kept up any great length of time.

Question 15. Is it necessary to apply the same quarantine regulations with this disease as with surra and glanders?

Answer. No. The precautions to be taken to prevent the spreading of this disease are as follows: The animal infected should be kept in a separate stall, and the healthy animals should not be allowed in this stall. Separate brushes, watering pails, and rubbing cloths should be used for the diseased animal. The stable should be disinfected at least twice a week, while the stall and brushes used for the sick animal should be disinfected daily.

Question 16. Can an animal suffering from lymphangitis be used for work purposes?

Answer. Yes; the animal can be used on the farm, if the ulcers are not where the harness will touch them. Horses having this disease should not be used in public places where they may come in contact with other animals.

METHODS OF DISINFECTING.

Some of the more important methods of disinfecting corrals, sheds, and stables where live stock is kept are as follows:

1. Keep the premises dry but not dusty. If the land is low remove the water by digging drains or filling the land above the water level.

2. Keep the premises clean and free from accumulated manure, soiled bedding, and litter.

3. Admit sunlight freely, as it is the principal agent in keeping premises dry, and strong light is one of the best disinfectants nature has ever provided. A building infected with rinderpest or other contagious disease can often be cleaned by removing the roof and leaving it exposed to the heat and light of the sun for a few days.

4. Fire and artificial heat applied in a number of ways are among the most valuable disinfecting agents. Straw, trash, litter, bedding, feed troughs, and interior fittings of buildings which have become infected and are liable to serve as a means of spreading diseases should be burned. Where structures are of such nature that a gasoline torch can be used without setting fire to them, the surfaces can be burned over or charred by this means, or other convenient form of torch giving a high degree of heat. A very reliable method which can be used on any kind of structure is to pour boiling water over the surface to be disinfected. This method is so commonly used and so valuable in the control of human diseases that it deserves thorough consideration in disinfecting premises where animals are kept.

5. CHEMICAL DISINFECTING AGENTS.—There are many of these, but only a few which can ordinarily be obtained at any drug store in the provinces will be mentioned here.

Lime, when freshly burned, is a very valuable disinfectant. After it has become slaked by absorbing moisture from the atmosphere it loses

much of its disinfecting power. It can be used by sprinkling the dry lime over damp places about the corrals and buildings or mixing it with water and salt to form a whitewash to be applied to surfaces such as fences and the walls of buildings.

Carbolic acid.—Mix 1 part of crude carbolic acid with 20 parts of water and sprinkle or spray the surfaces to be disinfected. This solution should not be applied to animals or the hands of laborers, as it is liable to blister the skin.

There are a number of coal-tar products sold under different names such as creolin, chloro-naptholeum, zenoleum, and Jay's fluid, all of which form a white milky fluid when mixed with water. They are cheap and can be mixed with water in any proportion from 1 part of disinfectant with 20 of water to 1 part disinfectant with 5 of water, and will not blister the hands.

Bichloride of mercury.—This is a strong poisonous chemical, usually put up in compressed tablets ready to dissolve in water giving solutions having a strength of 1 part chemical with 5,000 of water to 1 part chemical with 500 water. The latter solution is very strong and should be used with great care to avoid poisoning the animals. It is especially valuable for pouring over surfaces like concrete floors, troughs, and fences, and as a bath in which to soak harness, ropes, and grooming implements.

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Bureau of Agriculture.

SEED AND PLANT DISTRIBUTION.

MAGUEY PLANTS.

For the guidance of those wishing to secure maguey plants from the Bureau of Agriculture the following statement is issued:

PLANTS FOR DISTRIBUTION.

The Bureau has ordered from Hawaii, with the promise of delivery in June, July, and August, 1,000,000 pole plants and 500,000 sucker plants.

The 60,000 nursery plants growing at Singalong will be ready for delivery in June and the 350,000 native nursery plants growing at Lamao will be ready for delivery in September and October.

DISTRIBUTION.

These plants will be distributed free of charge to parties requesting them, for their own use, as follows:

500 Hawaiian pole plants, or
200 Hawaiian sucker plants, or
400 Native nursery plants.

No free distribution will be made of over 500 plants to one person.

Parties wishing larger quantities will be required to pay for them at the following rates:

	Per 1,000
Hawaiian pole plants, - - - -	₱6.00
Hawaiian sucker plants, - - -	18.00
Hawaiian nursery plants, - - -	20.00
Native nursery plants, - - - -	6.00

Hawaiian nursery plants will not be sold in lots of over ten thousand to one person.

Parties ordering plants not on the free list should send post-office money order for amount of purchase.

Literature on the subject of maguey growing in the Philippine Islands can be secured from the Bureau of Agriculture.

CEARA RUBBER.

The Bureau of Agriculture has received recently a supply of Ceara rubber seed from La Granja Modelo, La Carlota, Occidental Negros. This seed will be distributed without charge, and persons desiring the same should forward applications promptly.

G. E. NESOM, Director of Agriculture.

THE PHILIPPINE

Agricultural Review

VOL. I APRIL, 1908 No. 4

CONTENTS AND ILLUSTRATIONS.

CONTENTS.

ILLUSTRATIONS.

EDITORIAL.

CROP REPORTING.

With this number we publish for the first time notes on the condition of crops throughout the Islands. These notes were compiled from reports received from our volunteer crop reporters. By glancing over this article the reader may see that more than half of the municipalities and practically all of the provinces and important islands are represented in this report. It represents crop conditions in the dry season. One who is accustomed to seeing only the system of farming and crops grown in the vicinity of Manila may be surprised at the crop conditions shown by this report.

The reader is requested to see if his municipality is represented in this report. If not it is probably because we have no reporter there, and we would appreciate the efforts of every one who will assist us in getting a reliable monthly report from every municipality in the Archipelago.

LIVE-STOCK DEPOTS.

Restore agriculture to its former prosperity. Give the people more work animals. Stop the ravages of rinderpest, surra, and the other fatal animal diseases. These have been said and reiterated many, many times in reports, speeches, and interviews on general conditions in these Islands; Mr. Taft said so when he inaugurated the Philippine Assembly; every Governor-General has taken the same view; the Secretary of the Interior agrees and the Director of Agriculture is sure that his usefulness here depends largely on his ability to solve these problems. Can they be solved? What is your answer?

Rinderpest is the key to the situation. Stop that disease and the remainder is comparatively easy.

One of the most effective agents to use against any disease is quarantine. If the disease is being imported use the quarantine at the port of entry and prevent it from spreading to the provinces. Act No. 1760 is enough in the way of quarantine law, but the most important part of this system of controlling diseases has not been provided, namely, live-stock depots in which to store animals undergoing quarantine.

A definite move has now been made, both in the Commission and Assembly, for securing the necessary appropriation for this purpose. The principal depot will be located in Manila and there are to be smaller ones in Iloilo, Cebu, and possibly other open ports of the Islands. These depots will serve as an almost positive guarantee that infective diseases of animals will not be imported through them into the provinces.

MANIOC OR CASSAVA.

By Edwin B. Copeland.

> Cassava comes nearer furnishing the Florida farmer with a more universally profitable crop than any other which he can grow on equally large areas. It can be utilized in more ways, can be sold in more different forms, can be more cheaply converted into staple and finished products, and can be produced for a smaller part of its selling price than any other crop.

This quotation is from a bulletin of the Florida Agricultural Experiment Station. The plant it speaks of can be grown more cheaply in the Philippines than in Florida, and will here produce much larger crops. As a food, especially as a famine food, it has the great advantage, in addition to its cheapness, that it will keep in the ground for long periods, without deterioriation, and can be harvested at any season. For these reasons a note as to its origin and nature and its production in other countries will be of interest, and a description of its proper cultivation and its utilization and values will be valuable.

The writer has for several years been studying this plant in the Philippines. During the past six months, Dr. R. F. Bacon, of the Bureau of Science, has been associated with him in a more detailed study of it, and this paper, except in the writing, is their joint product. Material has been obtained and analyzed from a number of places. The cost of planting has been tested on a commercial scale, and different methods of extracting the starch have been tested as to efficiency and practicability.

DESCRIPTION.

Manioc or cassava is the plant known botanically as *Manihot utilissima,* of the family *Euphorbiaceæ.* This family includes, among other useful plants, several sources of commercial rubber, as the Para, and the genus *Manihot* itself includes Ceara rubber and several other species which seem likely to prove useful in the same way. There are more than 80 varieties of manihot, all natives of tropical or subtropical America. Throughout the Philippines manioc is known as "camoting cahoy" (sweet-potato tree) or by an equivalent name; but in Cagayan it is more commonly called "camote moro."

Manioc is a perennial shrub with a branching stem and palmate leaves, whose divisions are usually 5, 7, or 9 in number. As result of long

propagation by cuttings, it rarely forms seed; when it does, the staminate and pistillate flowers are borne separately on the same plant and the seeds are in shape and size like those of castor bean (the tangantangan of the Philippines). At the base of the stem is a cluster of long, fleshy roots, which are the valuable part of the plant. All parts of the plant contain a poisonous, milky juice. The poison contained in this is hydrocyanic (prussic) acid. Some varieties contain very little of this and are called "sweet;" others contain much and are called "bitter." None contain enough so that it could profitably be extracted. The poison can be completely removed by perfect washing or drying of the ground roots, by roasting, or by long boiling.

HISTORY.

Manioc is very old in cultivation in tropical America, having been the staple cultivated crop throughout that region at the time of the discovery by Europeans. Very soon thereafter it was taken to Africa, and probably to the Far East, by the Portuguese. Its spread over the tropics of Africa was rapid, and numerous varieties have been developed there and in Madagascar. There have been several more recent independent introductions into India and Malaya. It has long been grown in a small way in the southern United States, but on a large scale only within the last decade. Within a generation or two it has come into fairly general use by the natives of Hawaii, and has taken the name of "pia," which to the older inhabitants meant arrowroot. There is no record of its introduction into the Philippines, but it is found in limited use throughout the Archipelago, and as the staple crop in the Islands between Zamboanga and Borneo.

VARIETIES AND TOXICITY.

It is very probable that, as is true of some other cultivated plants, the cultivated manioc has several wild ancestor-species, which can no longer be distinguished. However this may be, a great many varieties are known in cultivation, and many of these have certainly been developed since the plant was domesticated. In Brazil more than fifty varieties are distinguished, most of which are bitter. In Paraguay and in Columbia only sweet varieties are regarded as worth cultivating. In the latter country, twenty-three varieties were collected in a single season for testing in Jamaica; in which island twenty-two, mostly bittter, varieties were already grown. In German East Africa ten varieties are described. In some parts of India as many as twenty-four varieties are distinguished, in others, not more than one. At least four each are known in Ceylon and Madagascar, in the United States four varieties were formerly recognized, and a large number have recently been imported from Porto Rico and elsewhere, to be tested. In the Philippines there are no varieties

distinguished by name, but a considerable difference in toxicity is recognized.

It is customary to group the varieties as sweet and bitter, and the two groups are often regarded as distinct species. However, no other character has been found which everywhere distinguishes them, moreover there is no line between them, the most and the least bitter being connected by varieties and strains with every intermediate degree of toxicity. Nor is the degree of bitterness a fixed character, but certainly depends upon the environment. Sweet varieties taken from Colombia to Jamaica have almost all become more poisonous within a few years. On the other hand, varieties taken from Jamaica or Central America or Mexico become sweeter, as also do bitter varieties taken from Jamaica or Porto Rico to Florida. The Guarani Indians of Paraguay claim they have derived their sweet varieties by very long cultivation, from a decidedly poisonous wild ancestor and that the bitter varieties cultivated by the peoples to their north represent intermediate steps in this development. From Florida experiments it seems likely that in the same plant the amount of poison is not at all times the same. In all varieties the thin, dark bark of the root is very poisonous, and the cortex, which as a rule is easily peeled off, also contains a dangerous amount of hydrocyanic acid. It is only the pith which is sweet in some varieties and bitter in others.

Beside the free hydrocyanic acid, which is in a condition to cause immediate poisoning if enough of it is present, there is usually more of the poison combined presumably in the form of a glucoside. When the roots are taken from the ground they very soon begin to decay and this glucoside breaks down, setting the hydrocyanic acid free. In this way a wholesome root may within a few days become very dangerous. In New Caledonia, the roots are sweet and edible when freshly dug, but fatal even to hogs three days later, and at Manila we have had roots which were perfectly sweet, so far as the senses told, change so much in three days that their grated pulp could not be smelled without acute discomfort. The change is usually less rapid.

USES.

The mânioc roots furnish the chief food of human beings in most parts of tropical America, in many parts of tropical Africa, and in some parts of Malaya and Polynesia. Roots of sweet varieties are sometimes eaten raw. More commonly, whether they be sweet or bitter, they are boiled or roasted, but as a general rule, meal is made from them. The meal is prepared in various ways. Everywhere, unless it be in Africa, the roots are first crushed by pounding (the primitve American way), rasping (in the Philippines and elsewhere), or between rollers. Before the pulp is dried the juice is usually squeezed out of it, but this process wastes

considerable starch. On the uses and value of this meal, I quote from Dr. James Neish, a physician of Jamaica:

> The grated pulp, washed and dried, is known under the name of cassava flour or farina when it has been heated and pounded. * * * When reduced into small lumps and only slightly heated, it (farina) is called *coñague,* a native term. When simply grated and dried at the fire in the form of a pikelet or muffin (the *torta* or *bunelo* of Spanish America) it is called *cassava.* * * * It is generally consumed under this form in French Guiana. * * * The starch dried in the open air is known as *cispa* or *moussache*; from this sweetened cakes are made, and other very agreeable dishes and pastry. * * * Cassava starch can be made use of in the preparation of all kinds of cakes, just as flour or the common starches. It gives them a particularly agreeable flavor, and greatly increases their hygienic and nutritive properties. Prepared with boiled milk, cassava starch is highly digestible and should freely be given to young children. Mixed with even a small proportion of ground malt its digestibility is increased, and it then vies with more expensive articles which are much advertised.

The coarsest meal is called "couac." The crude pulp, or squeezed or more or less washed pulp, or the crude or washed starch, is heated in various parts of the Tropics in a variety of ways, forming products more or less like pure tapioca. In some of the West Indian islands the people bake the cassava bread hard and store it, sometimes for as long as twelve months. In East Africa the meal is dried in the sun so that it can be kept for six months.

While a comparatively small part of the starch which becomes an article of commerce is used as food, it is more readily digestible than any other kind of starch produced in great quantities, and has a superior flavor. Its rivals as high-grade food starches are the several kinds of arrowroot, all of which are decidedly more expensive. The old trade name of pure manioc starch was "Brazilian arrowroot."

Tapioca is made by squeezing, rolling, or shaking the moist starch into round pellets, commonly by forcing them through a cullender onto a piece of shaken canvas. These pellets are then rolled or fall onto an iron plate or table, which is also shaken and whose temperature is about 100°C. The heat causes a partial conversion of the starch into sugar, and makes the pellets swell somewhat and become gelatinous in appearance. The product of this treatment is called "pearl tapioca." If the pellets are 1 to 1.5 millimeters in diameter, it is called "seed tapioca;" and if they are 3 millimeters in diameter, "medium pearl;" if they are 5 millimeters in diameter, "bulled pearl." "Flaked tapioca" is heated and changed in composition in the same way, without being previously put into the pellet form. Tapioca is a large export of Brazil and the Straits Settlements. The highest-priced tapioca is from Rio Janeiro. That from Bahia is yellowish, not being made from clean starch, and brings a quite inferior price.

Boiling the juice squeezed out of the roots drives off whatever poison

may be present. The natives of Paraguay make molasses by boiling down the juice of a very sugary variety. "Cassareep" is a boiled-down juice of a similar consistency, made usually from bitter manioc in the northern part of South America; it is flavored with meat juices and pepper to make the sauce known in the West Indies as "pepper-pot." "Piwarri" is the product of chewing and expectorating the roots and then letting them ferment.

The leaves are stewed and eaten as greens in Java and Africa.

The foremost aim in the development of the manioc industry in the United States has been the use of the roots as food for cattle. The experiments made to this end have not all come up to the too roseate anticipations. Manioc contains a greater percentage of nourishment than does any other root crop, but by itself it is a most unbalanced ration. When it is fed alone, or with another crop rich in carbohydrate but not in proteid, it is only natural that cattle presently tire of it and lose weight. When the roots have been used for starch manufacture, more than half of the refuse is still often made up of starch, for the sake of which this waste has still a fodder value. This waste is called "bitty." Manioc, whether the whole roots or the bitty, ought clearly to be fed on a large scale only when accompanied by some other food, which must be rich in proteid. Manioc is the principal fodder raised for cattle in Mauritius.

Peanut fodder suggests itself for such use in the Philippines. In Paraguay cattle are fed on the tops of the manioc plant, and are said to take well to this diet and thrive on it. Experiments with hogs in the United States have given better results than those with cattle, and in the Straits Settlements the bitty is regularly used for hog feed. Cassava is fed to poultry in many places. In the United States it has been found that it is excellent for fattening fowls, but does not make them lay well. For use as a fodder, the failure of manioc to keep after it is dug is more than counterbalanced by its remaining sound indefinitely if left in the ground.

In the Philippines the pith is sometimes carved or strung and used for curtains.

Under existing trade conditions, the most profitable use which can be made of manioc on a large scale is the manufacture of starch. This product is known commercially as Brazilian arrowroot, tapioca flour, or cassava or manioc starch. The cheapest starch is corn starch, whose price is normally 3 to 3.5 centavos a pound. As a bushel of corn is normally worth 80 centavos, weighs 56 pounds, and contains 63 per cent of starch, it will be seen that the manufactured starch sells for only about 1 centavo a pound more than it costs in the grain. As will be seen later, it would be possible to produce manioc starch and sell it in competition with corn starch, but this is fortunately unnecessary. The

other greatest source of starch is the potato. The price of potato starch is ordinarily fully twice that of corn starch. When used in laundry work or in cloth manufacture, potato starch makes a less stiff, more elastic finish, and enters much better into the fabric or thread than does corn starch. Before cotton thread can be woven, it is practically necessary that it be starched or "sized" to fasten in the loose ends of the fibers. If corn starch is used, the thread not only becomes unduly stiff, but also, since the starch does not enter into it well, but rather covers it, unduly thick. The threads will therefore not lie as close together, and the fabric woven from them becomes loose and slimpsy when the starch used in sizing is washed out. The finer the fabric to be made, the more imperative is the demand for a fine sizer.

The consumption of starch by cloth factories is very great. Beside using practically all the home product of potato starch, the American factories are obliged to import it from Europe. The United States production of potato starch in 1899 was 15,500 tons. In Germany the annual production is nearly 300,000 tons. The average starch content of potatoes used in starch manufacture in Germany is 18.7 per cent, or 11.22 pounds per bushel, but by no means all of this can be extracted. In Wisconsin, where the manufacture of potato starch is perhaps better developed than elsewhere in the United States, 8 pounds of starch from a bushel of potatoes is regarded as a high yield. Even though potato starch sells as high as 8 centavos per pound, it is clear that it can only be made from cheap potatoes, and that any profit, and indeed the safety of the business, depends on the most complete feasible extraction of the starch.

To appreciate the strong commercial position of manioc starch, it is only necessary to appreciate the enormous annual consumption of potato starch, and to understand that the latter product is now sold at so nearly the cost of production that it is only by the use of expensive machinery for the most complete extraction of the starch that the business can now be conducted at a profit. While potato starch is produced at any profit at all, manioc starch on the European market can not fall below 8 centavos a pound, for, in every respect in which potato starch is better than corn starch, manioc starch is better still. This is true for use as food as well as for manufacturing purposes.

The manioc starch manufactured in the United States is at present consumed entirely in cloth factories, and none of it appears on the open market.

The manufacture of starch will be described presently.

Beside starch, manioc roots contain some cane sugar, usually 4 to 6 per cent. This is lost in the manufacture of starch, but is utilized along with the starch if the roots are used for the manufacture of alcohol or glucose. The manufacture of glucose in this part of the world would

not be likely to be profitable, because of the low price of cane sugar. Several papers have been written which treat of the manufacture of alcohol from manioc, but so far as we know no manioc is used commercially in this way. The steps in the process are the conversion of the starch into sugar, fermentation, and distilling. None of these require much time or expensive machinery.

Alcohol in the Philippines is almost all produced by fermenting the bled sap of nipa and other palms. It is rather expensive, the cost to the manufacturer for a grade of 95 per cent being probably 85 centavos a gallon. The total convertible and fermentable matter in rich manioc reaches 35 per cent, half of which can be obtained as alcohol. With reasonably good work it should be safe to count on a yield of 16 per cent. Now, if the available starch in 100 pounds of roots be reckoned at 22 per cent, and its local value at 7 centavos, it is worth ₱1.54; the same amount of roots should yield 16 pounds or 2.3 gallons of alcohol, the value of which, based on that assumed for the starch, is 67 centavos a gallon. This assumes the cost of plant and manufacturing to be equal, which is not unreasonable. Alcohol at this price would find a ready market in Manila. As a matter of fact, so far as the cost of production goes, it is probable that industrial alcohol made from manioc could be placed on the Manila market in competition with kerosene, and still be profitable.

In view of the size and steadiness of the world's starch market, we believe, as already stated, that the best present commercial use of manioc is as a source of starch; but the local market for alcohol is valuable as a guarantee that no crisis in the starch market and no increase in production will jeopardize Philippine investments in manioc.

CLIMATE AND SOIL.

Manioc is essentially a tropical crop. Even the hardiest varieties are killed by any frost that kills tomatoes. As a result, growers in the United States must use the earliest varieties and harvest their crops in from seven to nine months after planting. The average yields with decent cultivation are not over 5 tons of roots per acre. This is as high a yield as could be counted on in the Philippines in the same time; in the variety that is raised here, it is after this age is passed that the most rapid growth occurs. As the plant is reproduced by stem cuttings, it is necessary in a country subject to frosts to bury the stems during the winter. This makes seed material somewhat expensive and of low vitality, so that a considerable percentage of the cuttings set out are likely not to live, and this in turn leaves vacant spots in the field and cuts down the yield. It is only in lands nearer the equator, where the temperature is comparatively uniform and moderately high, that manioc can develop with its characteristic luxuriance. An altitude of 3,000 feet is the upward

limit of the common occurrence of manioc in Hawaii; in the Philippines its culture for food can well be carried higher.

Aside from the fact that it must be warm, manioc is very modest in its demands upon the climate. To drought, the arch enemy of most cultivated plants, it is fairly immune. For the month or so after the cuttings are planted, they need as much rain as do most other plants at the same stage of growth. After this time, a moist atmosphere and occasional rain promote a most thrifty growth and the succulence of the roots. Roots used for food have a better texture in wet seasons than in dry. Dry weather, however, at least such dry weather as occurs in the Philippines, never kills manioc, and rarely, if ever, comes near stopping its growth. The typical insular climate, with a moderate amount of moisture in the air at all times, is most favorable for manioc. Never is it seriously injured by any drought occurring in these Islands, and it is likewise not hurt by heavy rainfall, unless it grows in heavy and undrained soil.

As is true of all drought-resisting plânts, manioc wants all the light it can get, and plants at all shaded or planted too close together most not be expected to be very productive. The ideal soil for manioc is rich, fairly deep, and open. Since very rich soils are often compact and heavy and undrained, and since its tolerance of drought makes it thrive better than most cultivated plants on sandy soils, these are in many places regarded as especially favorable to it. The roots do not endure standing water in the ground around them; low, heavy soils should therefore be drained or used for some other crop. When heavy soil is used in Jamaica, manioc is planted in raised ridges and this is the general practice in the French West Indies. The harvesting of the roots will obviously be easier and more complete in light than in heavy soil.

As to the demands of manioc on the food in the soil, there are two opposite opinions, some writers claiming that it is conspicuous among cultivated plants for the rapidity with which it exhausts the soil; others, that it is like other starchy crops in taking very little from the ground. The former view is supported by, and is probably due to, the fact that in the Straits Settlements, Africa, and to a large extent in South America, manioc is raised on forest clearings, which are used a few times and abandoned. When starch became a staple product of the Federated Malay States, a large amount of land was cut over in this way and then abandoned, with the result that the destruction of the forest was out of proportion to the permanent agricultural development. The Government met this difficulty by refusing to lease land for manioc cultivation unless some permanent crop, such as cocoanuts or rubber, are planted at the same time, and this regulation has been widely construed as evidence that manioc is a robber crop. But it is no peculiarity of manioc that it thrives best on virgin soil. Various Philippine crops, including upland rice, are raised according to exactly the same system, and one of the hardest

problems in forest regulation here has been the constant abandonment of plats of cultivated land and the making of new "caingins" or clearings for temporary use. Chemical analyses do not at all support the view that manioc is a hard crop on the soil. The total ash in the roots is commonly less than 2 per cent of the dry weight, and the nitrogen hardly more than 0.5 per cent. Manioc does use nitrogen in the formation of hydrocyanic acid, beside in the ways common to most plants, and may therefore exhaust this food disproportionately. This danger can be avoided by raising a leguminous crop with the manioc or alternating with it. The most promising leguminous crop here is the mongo. Unless the soil is rich in lime, the addition of this cheap food will be good for both the mongo and manioc.

ENEMIES.

A scale in Africa causes yellow spots on the leaves and leaf-miner lives in them, but neither causes appreciable damage. The same is true of insects which occasionally gnaw them. Old roots left in the ground in the Philippines are often chambered or consumed by insects, but young or fresh roots are never attacked.

Leaf-spot fungi occur in the Malay States, Africa, and America, but nowhere do appreciable damage. The only known serious disease of manioc is a leaf curl in East Africa, called by the natives "maratschi." It is a communicable disease, but no microörganism is known to cause it. No variety of manioc is free from it. A Madagascar variety called *Mpesazi*, is the least generally attacked. A sound plant of this variety twelve months old may have 12 kilograms of roots, but the average yield of thirteen plants with the leaf-curl was only 0.41 kilogram.

No disease of manioc is known in the Philippines. Their most dangerous enemy here is the hog. Wild hogs do considerable mischief when they get access to manioc, but they of course can be kept out by good fencing.

CULTURE.

Knowledge of what is really best in the culture of manioc is very limited, the plant never having received a fraction of the study which has been bestowed on all the important crops of temperate lands. On manioc we have for the most part only scattered observations and these are not always too reliable. In the equatorial belt, where manioc thrives best, the most usual treatment of it is the most complete neglect. The only attention it usually receives in the Philippines is sticking the cuttings into the ground and digging out the roots; and in parts of India, Africa, and South America it receives no more care. The most careful study has been given it in Florida and Jamaica; in the former all the conditions are very different from those here, and in the latter the subject most studied has been the selection of varieties.

Manioc is in practice always reproduced by stem cuttings. Seeds are used in the Government work in the United States in attempts to secure new and sweeter varieties and in German East Africa in attempts to secure immunity from disease. So far as limited and unsatisfactory experiments show, the seedlings are likely to have sweeter roots than their parents. However, in Paraguay the seed of the sweet cultivated varieties is said be to be very unreliable and likely to produce poisonous roots. The stems will grow if used as soon as cut and are presumably most vigorous then; but they have stood shipment from Jamaica to India and in Paraguay have been kept alive through six months of hot weather, provided the epidermis was not bruised or broken and they were kept dry.

Only sound stems of sound plants should be used. Cuttings 10 to 20 centimeters long will produce thrifty plants. Some writers advocate the use of longer ones, and it may be that their use where there is plenty of material for propagation will give the plants as tronger start. The cuttings are buried horizontally in some places, placed erect with the lower end in the ground in others, and planted obliquely in still others; they grow everywhere. The crop will perhaps be more easily harvested if the cutting is not erect. If it is erect it is advisable to plant in the ground the original lower end, so that the polarity of the cutting will not have to be overcome when it begins to grow.

Statements as to the proper distance between plants differ widely, and this depends of course upon the soil and climate, and upon the natural growth of the variety planted. On good soil a distance of 1 meter in each direction can be recommended for the Philippine variety; this puts 10,000 plants on 1 hectare of even ground. If more room for cultivation in one direction is desired, the same stand can be obtained by putting the rows 125 centimeters apart and the cuttings 80 centimeters apart in the rows. A somewhat more ample spacing is better, if a short-lived catch crop is interplanted. Some writers condemn the use of any other crops with manioc, but it seems to me that if well chosen they have decided advantages. The use of cane in this way—as is practiced, for instance, in Mauritius and Réunion—is distinctly bad from the standpoint of either plant, for they compete throughout their lives and reach their greatest development at the same time. Maize is used on a plantation in Basilan, and is harvested and out of the way before the manioc needs all of the space. But if a catch crop is to be used, there is no reason why it should not be one which, like mongo or some other legume, will leave the soil actually bettered by its presence. There is at our door a market for mongos as human food, and there are various legumes which produce a fodder which could be mixed with the waste from the starch mill to make a well-balanced fodder for beasts.

While, so far as I know, no comparative tests have been made, there is no doubt that thorough plowing and harrowing have the same general

effect on manioc that they have on other crops. In the case of manioc, hard ground not only prevents the proper growth and activity of the feeding roots, as it does for other crops as well, but it interferes directly also with the development of the part of the plant to be harvested. Even if the fleshy roots became as large in hard and uneven ground—which they could not—they would still be less valuable, for it is much more difficult to clean and peel an irregular root than a stout, symmetrical one. Moreover, as has been seen, the bark and cortex are strong in hydrocyanic acid, while the starch is confined to the fleshy interior; therefore a stout and symmetrical root, having less surface in proportion to its bulk, will contain the least poison and the highest percentage of starch, while an irregular root or a very long one, such as may grow where the ground has been cracked, will be comparatively bitter and weak in starch.

While plowing is, in the abstract, desirable, we may as well recognize frankly that on freshly cleared tropical land it does not pay. The laborious removal of stumps and roots, work to which the native labor is not used, costs fully as much here as in the United States; while if fresh growth is kept down, termites and the teeming organisms of decay will destroy almost every kind of wood completely within a year or so. The land can be plowed for subsequent crops. Hand cultivation is cheap here, and can be made to give very good results. When manioc is planted on unplowed land each cutting should be set into a spot of thoroughly worked ground 20 centimeters deep and at least 30 centimeters in diameter. The plants should be in rows, as regular as possible. Because of stumps a given area will take less plants than could be put into land well cultivated.

If mongo is interplanted with manioc the two should be planted at the same time, so that the mongo may mature and be harvested before the manioc needs its room. If, as has already been suggested, the rows of manioc be 125 centimeters apart and the cuttings 80 centimeters apart, two rows of mongo, themselves 30 centimeters apart, can be planted between each two rows of manioc. The two crops will need but little more cultivation than should be given manioc alone. Whether or not the mongo is present, the land should be thoroughly cultivated not more than one month after planting, making the ground soft and fine, and killing all weeds—a weed is a plant of whatever kind which grows where it is not wanted. At this first cultivation it is advisable to hill the manioc slightly.

Mongo needs cultivation twice within the first two months, while manioc might do with one, but will certainly grow better for the greater attention. After the mongo is removed the ground will still want to be cleaned and worked once. After the plants are 4 or 4½ months old they take care of themselves.

The roots are ready to be used for human food at any time after they

are 5 or 6 months old. Sometimes all the roots of a plant are taken at once, sometimes they are dug one at a time. In these young roots the percentage of sugar is probably as great as it ever becomes, but they are relatively weak in starch, and less woody than older ones. The roots of the Philippine varieties are probably best suited for direct use as human food when they are not more than 9 months old, although we have seen succulent roots on plants said to be 16 months old, from which other roots had been removed earlier. In Hawaii, 2 year-old roots are often hard and fibrous, containing little starch. One African variety is edible when 6 years old. For making meal or manufacturing starch the roots can not profitably be gathered until they are well beyond the best age for direct use as human food; thus, in one African district they are eaten fresh when about 9 months old, and not used until 12 to 14 months old for making meal. In some parts of the Philippines the roots are said to be grated and eaten when 3 years or more old.

The best time at which to harvest the roots for starch manufacture ought to be very carefully determined locally wherever the manufacture of starch is an industry. In the Straits Settlements the Chinese are said to wait until the roots are 18 months old, while the European planters harvest their crop in about 10 months. In determining the most popular age, various factors must be considered—the weight of roots, their starch content, and the rental of the land, or its productivity if replanted, being the most important. The weight and the content of starch depend upon the variety grown, the climate and season, and the cultivation. The dependence upon variety and season is well shown in the following table representing the yield of five native Jamaica varieties. The 1907 crop had an exceptionally wet season.

[Bull. Dept. Agr. Jamaica 5 (1907) 78. Cassava trials in 1907. H. H. Cousins. Of 22 varieties, only the five which gave the largest yield of starch in 1907 are copied here.]

Variety.	Tubers (tons).	Starch per acre.			
		1907.		1906.	
		Per cent.	Pounds.	Twelve months (pounds).	Eighteen months (pounds).
Luana Sweet	13.3	33.61	10,015	5,322	7,102
Duff House	11.4	35.69	9,114	4,107	12,632
Black Bunch of Keys	11.4	34.85	8,899	2,388	8,894
Brown Stick	11.4	34.37	8,777	2,384	8,927
Blue Top	11.3	34.62	8,763	5,636	15,818

There were five other varieties in the 1906 crop whose yield of starch when 18 months old was over 5 tons per acre. As between 12 and 18 months, the general result is that for the sake of greater yield it is decidedly better to leave the plants a year and a half. Conditions in the

Philippines are the same. While the percentage of starch, a scant 10 in the roots of 5-month-old plants, reaches its maximum at about ten months, the most rapid growth of the roots is then only well under way. The percentage of starch begins to decrease, at least sometimes, before the plants are 12 months old, but the total amount continues to increase rapidly, and the slightly increased woodiness does not seriously interfere with its extraction.

When manioc is raised for food, the roots are dug like potatoes for use as wanted. When it is grown on a large scale, the plants are sometimes pulled by hand from very light soil, but the work is done much more easily by the use of a lifter. The simplest lifter is a straight wooden stick, 2 or 3 meters long, strong enough so that it will not break, which is used as a lever. The fulcrum end rests on the ground, and is provided on the underside with an old spade blade or some other flat body to prevent its sinking in. Near the fulcrum end is fastened a hook or other grappling device. By lifting the long arm of the lever and shaking, the plant is pulled out of the ground reasonably free from adhering soil. If some roots break off they are dug individually. When the field is in sufficiently good cultivation to permit plowing, a furrow is run alongside of each row, making the roots pull up more easily and with less breaking.

The yield of manioc has been the subject of day dreams. Semler, not too positively, cites a New Caledonia plantation whose yield in two years ranged from 25 to 250 metric tons of roots per hectare. Reports in German East Africa sent to the experiment station at Amani range from 2.5 to 225 tons. Such reports as these larger ones must be due to mistake or misunderstanding, or to computing the yield per hectare from that of a few exceptional plants. Single plants indubitably have produced 25 kilograms of roots, and 10,000 such plants on a hectare would yield 250 tons. But such yields do not occur. The yield of some notably good Jamaica varieties has already been given. Twenty-five Colombian varieties grown in Jamaica in 1907 produced 3.1 to 13.3 English tons per acre. From Florida there have been reports of 30 or 40 tons per acre and the average near the Lake Mary factory, where the figures should be reliable, has been given as 9 and 10 tons; but the average crop in the United States is not believed to be more than 5 tons. In Pondicherry 5 metric tons is the maximum crop expected from a hectare of well-manured plants irrigated five or six times a month during the dry season. In Ceylon and Java the yield is expected to be above 25 tons per hectare. A test crop 10 months old at Hué was 14.44 tons per hectare. There are no data as to the actual yield of any considerable acres in the Philippines, but from the unanimous opinion of growers and from our own observations and weighings of apparently representative plants, it is our opinion that 25 tons per hectare is a very low estimate of the yield fairly to be expected from a crop a year or upward old.

Many analyses showing the starch content of manioc have been published, but it is not worth while to copy them here. Data on the best Jamaica varieties have already been given. The matter of business interest is not the absolute starch content of the roots, but the amount which can be obtained by practical manufacturing methods. This of course depends on how much is in the roots, but to a greater extent still upon the methods used in its extraction, and the thoroughness with which it is worth while to extract must be settled locally according to the value of the starch and the cost of producing the roots. For this reason the same methods are by no means to be recommended for all parts of the world. The highest starch content I have seen published is 36.5 per cent in a Colombian variety grown in Jamaica in 1903 and called "Governor Hemming;" four years later the same variety contained only 30.17 per cent. By commercial feasible treatment we obtained here more than 31 per cent of air-dry starch, in one test.

STARCH MANUFACTURE.

The first step in starch manufacture is always and everywhere the same, the roots are washed *clean*. If any dirt finds its way into the mill, it will stay with the starch through the whole process of manufacture, and be in it at the end. A very little dirt destroys the perfect whiteness of the starch and only perfectly white starch can be sold at a good price. The washing can be done by hand or in a mechanical washer. Mechanical washing of most roots and in most places is much the cheaper, but the great and irregular size of manioc roots offers some difficulty. When the roots have been thoroughly washed, it is customary to peel them, removing the bark and cortex which contain no starch and at the same time to get rid of any last particles of dirt. If the roots are kept moist until decay begins the cortex will slip off readily in the hands, but this course is not to be recommended. If the roots are perfectly clean the removal of the bark and cortex is unnecessary, for they contain nothing which discolors or mixes with the starch.

The starch in the roots is contained in the cells of the pith. The starch grains are very minute, decidedly smaller than those of potato starch, and the cells containing them are also smaller. For this reason and because the roots are more woody than the tubers of potato, it is more difficult to extract the starch completely. The walls must clearly be broken to let the starch escape; the starch in any unbroken cell is lost with the fibrous part of the roots. The walls are broken by decay or by scraping, rasping, or crushing the roots.

The practice of letting the roots decay has been in use among the poor Chinese of the Malay States since about 1891 in making a low grade of tapioca, but not in the manufacture of salable starch. A Dutch writer,

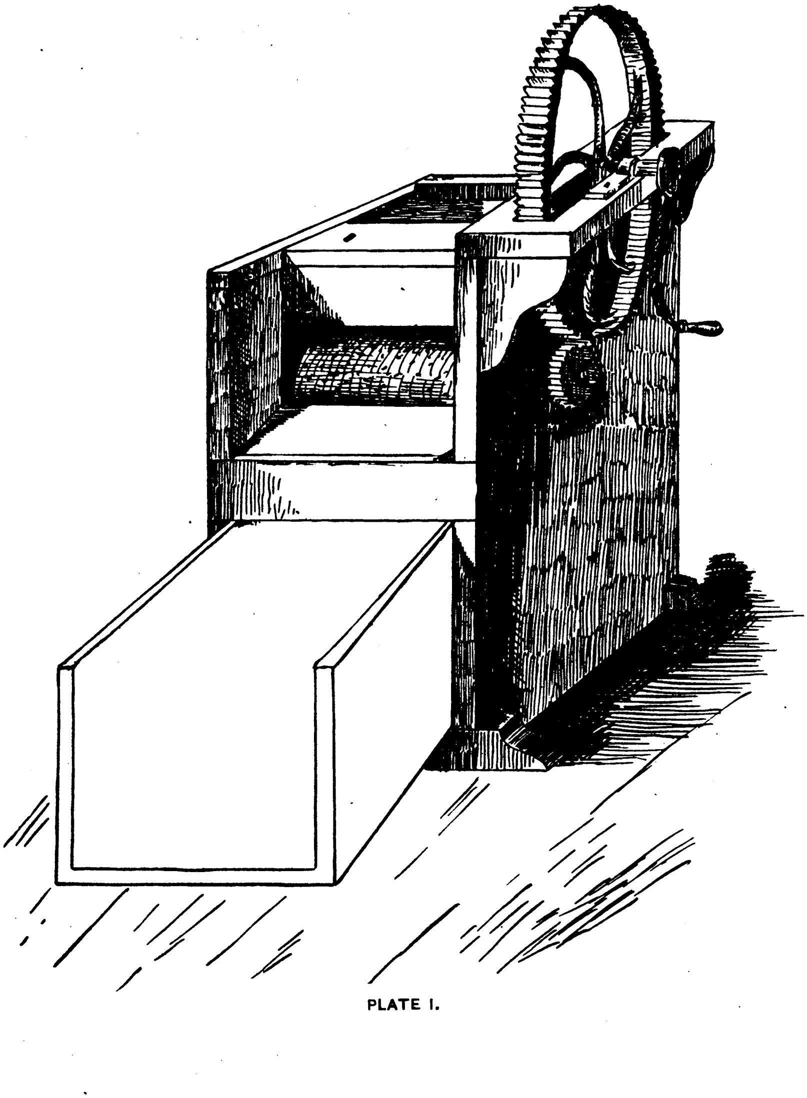


PLATE I.

de Kruijff (Teysmania, 1906, No. 8), has recently stated that by letting the walls decay it is possible to secure the starch very completely and of as good quality as is obtained by other processes. Anyone adopting this method will wisely try it at first on a very small scale.

The old Chinese method in the Straits Settlements, when that district first took a prominent place in the manufacture of starch and tapioca, was to wash the roots, peel them, wash them again, grind or crush them between rollers, strain out the fibrous part of the pulp with a sieve which permitted the starch to pass through with the water, let the starch settle, draw off the water, and wash until clean and dry. This was all done by hand. In the factories of Europeans steam power is in use and the roots are pulped by scraping.

Elaborate machinery for starch manufacture has naturally been developed in special adaptation to corn and potatoes. The first attempts at manioc starch mills on the same scale were made in Florida about a decade ago. The Lake Mary factory put in potato-starch machinery, and with it was unable to get more than 20 per cent of the starch from the roots containing fully 27 per cent. They have since made improvements—which at least, for the most part, should be used in potato-starch manufacture as well—by which, with cheaper plant and at a lower running cost, they get nearly or quite 25 per cent. The new process is the work of Archbold, who published a brief description of it in the Journal of the Society of Chemical Industry (1903, p. 63–66). The washed roots are scraped and milled. The pulp is then driven upward by a stream of water against a wire-gauze diaphragm, through which the starch and water pass. Instead of having the starch settle in still tanks, the milky mixture of starch and water is piped to near the bottom of a tank which has the form of a large inverted cone, in which the mixture flows upward. As the cone widens upward the rate of flow decreases until it becomes so slow that the starch settles against it; only the dirty water flows off at the top, and the starch is drawn off below.

To insure the quality of starch, there is one condition more important than all others—an abundance of clean pure water. The pulp must be thoroughly washed to separate the starch from the waste, and then the starch needs from two to sometimes as many as eight washings. If there is any evident impurity in the water, the starch may be relied upon to take it up. It is of course expected that the starch will be free from all particles of cellulose or wood; this is easily managed by the use of a *sound* fine sieve, whether of cloth or wire.

The completeness with which the starch can be extracted depends on how completely all the cells are broken. In the potato-starch factories and in Florida, the comminuation of the roots is accomplished by a rotating cylinder set with blades with saw-like edges. A cheaper mill

can be made by filling a sheet of iron or tin with holes by driving a nail into it, driving it always in the same direction. The sheet is then fastened around a cylinder. I quote from Bulletin 106, Bureau of Chemistry, United States Department of Agriculture, page 28: "A two-horsepower gas engine was used for grinding, the mill consisting of a revolving drum covered with a sheet of roofing tin punctured to make a grating surface. Over this a hopper was arranged, the whole resting on a suitable frame. This mill cost when complete, with shaft, boxings, and pulley, $10, and would grind 1 ton of tubers in one and a half hours."

The quality of the work of such a mill depends on the fineness of the projections, and the speed of the rotation. A cylinder with fine teeth will not work as fast as one with coarse teeth; but it will not use much more power in milling a given weight of roots, and for the sake of greater capacity it has only to be made longer. With such a cylinder whose projections are more than 1 millimeter high not more than 24 per cent out of 31 is likely to be extracted. With a cylinder whose projections are less than 0.5 millimeter high it is as easy to get 3 or 4 per cent more.

In the Philippines the roots can be produced at so low a cost that the use of expensive machinery for the extraction of the last possible percentage of starch would be foolish. The money that would be spent in the purchase and operation of such machinery will give a much larger return in starch if it is spent in producing more roots. The process of manufacture, as it can most profitably be carried out here, reduces itself to this:

1. Cleaning the roots perfectly.
2. Milling them on the rough cylinder just described.
3. *Screening the pulp:* This is simply and thoroughly done by running it through a trough with sieve bottom of cloth or wire. To make it screen well and quickly, the trough should be shaken and fine jets of water should play upon it.
4. *Settling:* Concrete tanks will, without doubt, prove most economical. For fast work in washing they should be shallow.
5. *Washing:* After the water is run off, preferably by means of cocks in the sides of the tanks, the starch must be washed with clean water and allowed to settle, and this must be repeated until it is perfectly white. To keep the starch from making a hard sediment and not being washed except on top, each tank should have a stirring paddle or set of paddles, which will best be worked by hand. Care must be taken that no dirt can fall or blow into the tanks.
6. *Drying:* How this is done will depend upon local conditions, but it will usually prove unsafe to rely upon the sun. If a drying house is used, it must be absolutely free from smoke and dust.

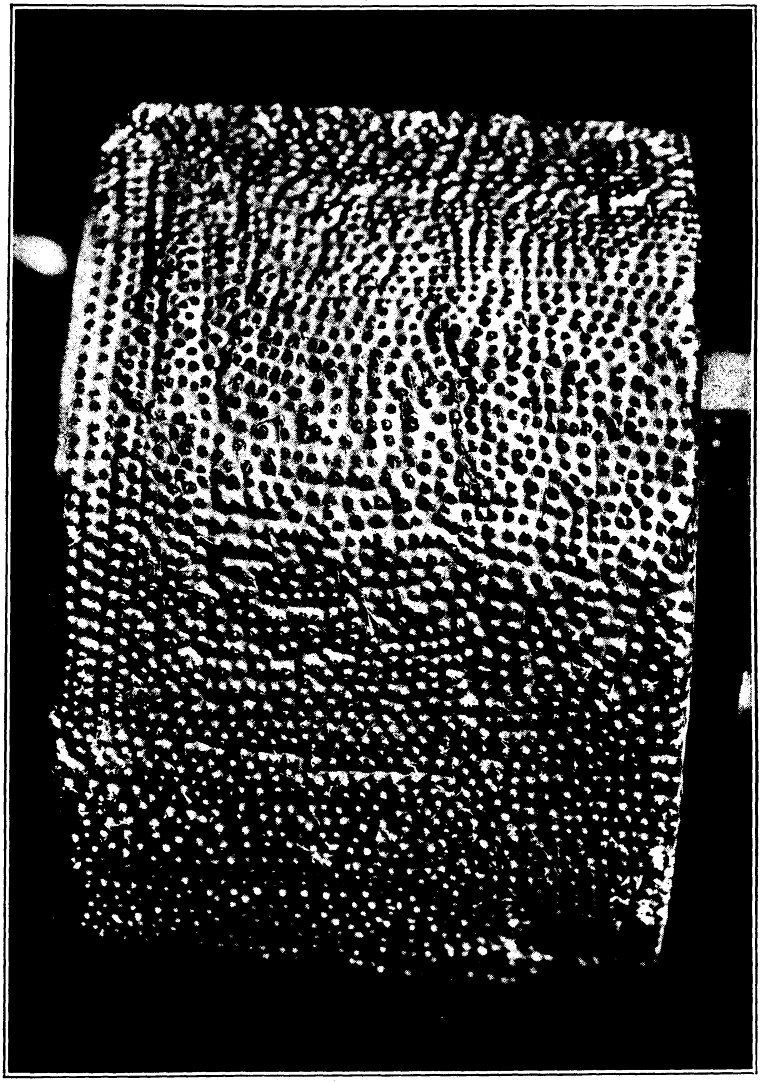


PLATE II.

COST OF PRODUCTION.

It would not be without interest, if it were possible, to make a detailed statement in support of the assertion that manioc production in the Philippines is remarkably cheap. But as soon as such statements become really detailed, they cease to have more than a very local value, and fit only the case of the individual whose experiments they represent. The cost of management and the items chargeable as interest, deterioration, and rent depend so entirely upon circumstances and the will of the planter that a general statement of them is valueless. Government land suitable for manioc culture is available in most parts of these Islands, and can presumably be leased for 50 centavos per hectare per annum, or bought at 10 pesos per hectare. A higher charge can legally be made, but it is not customary. Omitting these items a statement which I believe originated in 1900 in the Leersburg (Florida) Commerical, and has been copied widely, put the cost of production in Florida at $14.65 per acre. This included $4 for fertilizer, but did not cover the cost of digging the roots. In Jamaica, it was stated in 1904 as a summary of all estimates and experience that "Cassava should cost, for cultivation only, £3 13s. to £5 2s. per acre, according to locality and circumstances.

A Mindanao plantation, paying its laborers 60 to 75 centavos a day, has found its expense to be, in round numbers, as follows—

	Per hectare.
Stems for seed	₱1
Clearing	20
Planting	10
Cultivation, twice	20
Total	51

Or about ₱21 per acre. This provided for clearing *coarse* brush land, and the purchase of "seed," which is necessary only in the establishment of the industry. Harvesting the roots will cost approximately ₱25 per hectare, making the field expenses for the first crop ₱76. Five dollars a ton was the price originally paid by the Florida factories for the fresh roots, this has since been lowered, but the factories have increased their own area in cultivation. At this price, keeping the very low estimate of 25 tons, the crop would be worth ₱250.

SOME QUOTATIONS ON MANIOC.

The treatment of maize for starch and glucose is tedious and costly, whilst the process for cassava products is simple and cheap and the resulting products purer. Cassava is the cheapest known source of starch, costing at the above market values (45 cents per bushel in Chicago for corn) and existing methods of planting, one-fourth as much as maize starch. (Archbold, Journ. Soc. Chem. Industry, 22 (1903), 64.)

All kinds of stock eat it with relish and thrive upon it much better than when confined to any dry feed. (Tracy in U. S. Dept. Agr. Farmers' Bull. 167, 1903.)

For the production of starch and glucose it surpasses all other plants in the quantity producible per acre, and at a minimum cost. (Robert Thomson, in the Gardeners' Chronicle, 1903.)

The Indians of Columbia, who perform tremendous journeys among the mountains carrying immense weights, subsist largely on cassava, or yucca, as it is there called; so do the Indians of Guiana; while the mendioca and farinha (cassava and farina) are the chief support of the laboring people along the River Amazon, whose strength and endurance on scanty portions of farinha and fish and nothing else save pacovas, or plantains, have been the marvels of travelers in these regions. (Journ. Jamaica Agr. Soc., 1902.)

Its returns per hectare are so enormous that it is hardly possible that it will have any rival. The product of a hectare of manioc is enormous, and, by manufacturing, returns of 500 pesos a hectare should be obtained with certainty. (G. Eismann, in Der Pflanzer., 1905.)

PRACTICAL SUGGESTIONS ON POULTRY RAISING.

By George P. Ahern, *Director of Forestry.*

THE HOUSE.

A house 12 by 24 feet will accommodate fifty chickens. The house may be subdivided into two or three rooms and should be kept dry, free from drafts, well protected against storms, but arranged, if possible, to let in sunlight. Use boards for the sides, and in addition to a door, which should be kept locked except when cleaning, etc., provide one or two small openings, near the floor, 10 by 10 inches, to allow the hens to enter at will.

ROOSTS.

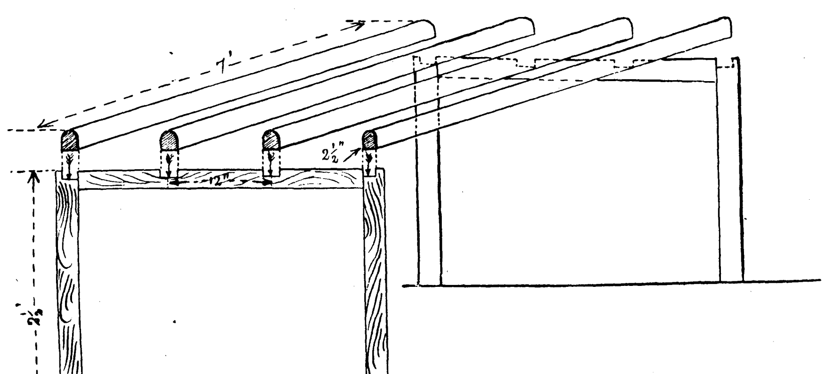
The proper size for roosts is 2 to 2½ inches wide and 2 inches thick with rounded edges, placed 8 to 12 inches apart and 30 inches above ground.

They should be made so as to be readily removed for cleaning. Four or five pieces of the above dimensions 7 feet long and resting in mortised supports give satisfaction and furnish space for fifty fowls.

Bamboo and tree branches are not desirable, nor should chickens be permitted to roost in trees.

The roosts should be on the same level in the house, for if one is above another all the chickens will strive for the top roosts; fights will result, and the output of eggs the next day will be diminished.

It is a good plan to have an inclined platform under the roosts and extending beyond with a cleat at the bottom to catch the droppings, otherwise more time is required to keep the floor clean. This is not a necessity; it merely simplifies cleaning the house.



Detachable Roost.

NESTS FOR LAYERS.

Nests should be exposed to view as little as possible, as the hens lay better under such conditions.

Satisfactory nests may be made by utilizing open-work Philippine baskets 8 to 12 inches in diameter and filled with straw or hay broken fine. A skeleton framework can be made to hold any number of baskets.

ABOUT SETTERS.

Nests for setting hens should be in a separate room. Provide boxes about 12 inches square and place a few inches apart. As many hens as possible should be set at a time. Avoid setting too many eggs under one hen, as a setting hen if not secluded, or if greatly disturbed at any early stage of the setting, is liable to abandon her nest. The necessity of having it in a quiet place is imperative. There should be food and water in the room, but no perches.

DUST BOX.

The dust box is one of the necessary things in the establishment. It should be 2 or 4 feet square and from 6 to 8 inches deep, filled with sand and ashes and carbolated lime, or road dust and a little lime. The contents should be always finely pulverized. It should be placed where it will get the sun and at the same time be sheltered from the rain. The hens will use this constantly and keep free from vermin. Instead of a box, a hole may be made in the ground surrounded by boards, provided it is protected from rain, and the earth kept finely pulverized.

CLEANLINESS.

Lack of cleanliness is the source of many diseases in chickens, especially if they are at all crowded, hence the necessity of keeping the house, yard, feeding and drinking vessels, etc., *scrupulously clean.*

Whitewash the inside of your henhouse frequently, using carbolic acid in the whitewash. The floor, preferably of cement or boards, should be cleaned daily, the platform under the roosts twice a week, and then sprinkled with dust or lime. The lime will make the chickens sneeze and thus clean out their nostrils. Red pepper in the food will acccomplish the same result, and stimulate egg laying.

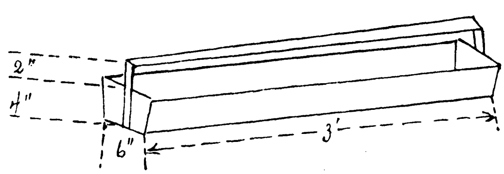
The roosts should be removed once a week, cleaned and rubbed with kerosene, and the supports as well. Disinfect all crevices in the henhouse as these are the hiding places for vermin. The laying baskets should be washed in a kerosene solution once a week and the straw changed at the same time. The setting box also should be kerosened whenever a brood comes off. Feeding trough and water vessels must be cleaned and scalded once a week.

FEEDING.

The chickens should be fed from a trough about 3 feet long and 6 inches wide with a slat running a short distance above the center to keep them from walking through the feed.

Put on back of stove at night a ration of palay covered with boiling water (just enough water to cover palay), and in the morning put in an equal amount of tiqui tiqui (bran) and ground oats, viz, where 2 quarts of palay is used, use 1 quart of tiqui tiqui and 1 quart of ground oats. Do not use any more water, as the food should not be too watery. Let it steam fifteen to twenty minutes, put in a pinch of salt and (occasionally) red pepper, and place in the trough. Corn meal may be used in place of ground oats and makes a desirable change. This mixed food should be given in the morning, and about 4 to 4.30 p. m. Dry palay thrown on the ground where it will fall on sand or grit and where they must scratch for it, constitutes the evening meal. Do not throw this dry food on the grass or on a hard floor. Some kind of grit must be taken by the chickens each day. For this purpose ground shell is sometimes provided.

Avoid overfeeding. All should have five minutes' feeding at the trough and anything left after that time should be removed.



FEED TROUGH.

Four ounces per hen is sufficient food for one day. She should scratch for part of her food each day, as it keeps her in good condition for laying.

There should be a run where they can get a little grass and gravel. Green cut bone is excellent for laying hens—give one ounce per chicken three times a week. Other green stuff, such as carrot tops or vegetables, cut fine, is beneficial.

Young chickens should be fed separately. Little observation will convince one that the young and timid get little chance at the food trough while the older ones are feeding.

CHICKS.

Young chickens should not be allowed water for the first thirty-six to forty-eight hours, as they are very subject to bowel trouble. Feed hard-boiled egg with its shell and dry bread crumbs, thoroughly mixed, several times a day for two weeks. They should be fed with the mother hen for five to six weeks. Keep them, at night, in a separate room, or in a box in a place free from drafts and safe from rats, etc.

LAYING HENS.

If you want your hens to lay you must observe the following rules:

Avoid handling or alarming the hens; a stranger in the yard, a dog, strange or disturbing sights and sounds will interfere seriously with the output of eggs.

The hens should have a wide, comfortable roost, free from drafts.

They must be kept busy.

Give a variety of food.

Avoid wet, mushy, carelessly prepared food.

Avoid overfeeding.

Hens that are too fat will not lay.

When the hens are not used for hatching put the roosters in a separate yard and the harvest of eggs will increase.

It is not wise to keep more than twelve to twenty hens in small city yards.

Keep twelve hens and follow the above rules and there will be eggs for breakfast every day in the year.

COCKS.

One cock for ten to twelve hens is sufficient, and that for only about three months in the year.

In the Philippines it has been found that a large percentage of chickens will be raised or hatched in December or January, just after the rainy season.

The chickens should be at least 1 to 2 months old when the hot season arrives.

Set eggs from about November 15 to January 15, but not after February 1, if you wish for good results.

In a limited space it is best to confine one's efforts to a single breed. The Plymouth Rock is the hardiest in the world; it is a good layer and makes an excellent table bird. Mix this breed with selected native hens.

By selecting fresh, well-bred roosters each year, you can improve the mixed breed until it is almost as satisfactory as the thoroughbred in color, shape, and size, and better than the thoroughbred as far as hardiness is concerned, as the mixed-bred will stand the rains and hot weather where the other will succumb.

Do not go to the expense of getting thoroughbred hens. The percentage of loss of thoroughbred chickens is so great in these Islands as to be discouraging to the average poultry raisers.

Fine cocks may be obtained from Australia, Singapore, Shanghai, and Japan. The importers of cattle and horses often bring in fine chickens.

Always quarantine hens bought in the market. If diseases do not appear within three or four days turn them out with the others.

Use for hatching only the eggs from your best hens; mark in pencil the date on each egg every day, with a letter to designate from which hen it came. It is comparatively easy to do this in a small yard.

If possible do not set eggs that are more than eight days old. Rounded eggs hatch better than long pointed ones. Eggs from fine laying hens will increase your chance of improvement in the laying stock. Like breeds like, and by carefully selecting your eggs each year the results are sure to be satisfactory.

HEN HEALTH.

Nearly all poultry diseases begin with colds; hence the oft-repeated warnings, keep them out of drafts in the henhouse. Do not let them run in swampy places and do not overfeed. If the dust box is not provided so that vermin may be checked the hen will lose vitality and thus become a ready prey to any of the common disorders. An ailing or sick chicken may be easily noted by one or all of the following symptoms: Droopiness, loss of color in comb and around the beak, lack of appetite, great thirst, and ruffled feathers.

You can not begin too early to treat it, and the first step is to separate entirely from the flock. Make it comfortable in a separate room or coop or a box that is dry and sunny and used only for hospital purposes. Keep supplied with fresh drinking water and give simply a change of food until the symptoms develop sufficiently to indicate what special treatment is required.

ROUP OR CROUP.

This is one of the diseases to be dreaded in the poultry yard. It is caused by cold, dampness, and exposure.

Symptoms: Loss of appetite, dullness, ruffled feathers, rapid breathing with a wheezing crowing sound, a thin discharge from nose and mouth which later becomes thick and fœtid. The head and eyes are frequently swollen. Yellowish-white fibers and raw sores appear on tongue and in mouth and throat. Red swellings appear on face and diarrhœa sets in later.

Treatment: Change the food, give green or cooked vegetables, cooked rice or cornmeal. Mix a little cayenne with food. Put a teaspoonful of carbolic acid in one gallon of water or dissolve a dram of chlorate of potash in each pint of drinking water. Wash nostrils and throat with this solution, which is also good for diphtheria, pip, and scaly tongue. Bathe the swellings and sore places two or three times a day with 15 to 20 grams of nitrate of silver in a wineglass of water, or bathe with water and vinegar or boracic acid.

CHOLERA.

Causes: Sour food, bad water, filth.

Symptoms: Thirst, dullness, ruffled feathers, drooping head and wings, unsteady gait, greenish yellow diarrhœa, sometimes frothy and, in an advanced stage of the trouble, bloody. Combs and beaks become dark colored—even black.

Treatment: When you think you have a case of cholera, promptly separate the sick bird from the others and as soon as possible disinfect house, drinking vessels, and food trough, as this disease spreads like wildfire. A simple remedy is to cover the top of the drinking water with kerosene and allow no other water, or use carbolic acid in proportion of a teaspoonful to a half gallon. Another treatment is to give ten drops of paregoric and five drops of spirits of camphor twice a day. Burn any dead fowls and remove and burn all refuse from house and run, and especially from the hospital.

The head and eye disease is also prevalent in the Philippine poultry yards. The sick chicken should be separated from the others. The feed should be carefully prepared, preferably cooked rice and vegetables. The swelling about the head should be washed in a kerosene solution or a weak solution of carbolic acid. Tincture of iodine is sometimes applied and may prove efficacious in light attacks. If the chicken does not respond promptly to treatment, kill it.

The above notes are gathered from personal experience; follow them as well as circumstances will permit. Do not leave the details to a muchacho. Give a few minutes' supervision each morning and evening. Make the hens comfortable and safe, give good food and water, and you will have surprising returns for your trouble.

PLATE III.

LA GRANJA MODELO.

This model farm (La Granja Modelo) was established by the Spanish Government about the year 1890, and it was for a long time managed by Don José Sanchez, who was a soil physicist, or agricultural engineer. The farm as it now stands was made up of a number of small claims owned by private parties, to which was added a considerable amount of public domain existing in that vicinity.

The first line of development on the place was the establishment of an observatory with meteorological apparatus and instruments for the purpose of making weather records from their observations in that vicinity.

Land was cleared, irrigation and power canals put in, and a small water wheel installed, together with a three-roller sugar mill, evaporators, etc., for experiments in sugar making. Among those who were assigned to duty as assistants to Don José Sanchez were a foreman, draftsman, weather observer, and students. The students received wages while in attendance at this farm, which enabled them to pursue their studies. The farm at this time had a large fine house for use of the agricultural engineer, suitable observatory and school buildings, and the observatory and laboratory were equipped with good instruments.

This farm was kept in operation by the Spanish Government until 1896. At the beginning of the insurrection in 1896, when the Spanish Government ceased to operate the farm, it was taken over by the Negros independent government, but much of the apparatus, records, and equipment had been removed to Manila. In 1898 when the American military authorities took charge of the Island of Negros, the farm was converted into a temporary military post during the provisional military government formed in that island under Gen. James F. Smith.

The Negros independent government placed Francisco Perez in charge of the farm, until relieved by Santiago Morales, who in turn continued in charge of the place until Don Juan Araneta was made secretary of agriculture for the Negros independent government. General Smith appointed Don Juan Araneta to take charge of the place in the name of the United States Government, who continued manager of the estate until 1901, at which time it was transferred to the central government and later turned over to the Bureau of Agriculture for operation.

At the time Don Juan Araneta took charge of the farm for the Negros independent government, he packed up all furniture, apparatus, and

equipment and hauled them to his home about 8 or 10 miles away, where they were stored until the establishment of the American Government in the Island of Negros, after which he returned them to the farm. In this move much of the apparatus was lost, or injured in such a way that very little remained useful at the time the farm was transferred to the Bureau of Agriculture.

The Bureau of Agriculture began operation of the farm in the year 1902, with A. P. Hayne as superintendent. He remained there until December 31, 1903, at which time he was succeeded by John Heil, who left for the United States on vacation in April, 1905, and subsequently resigned. He was succeeded as superintendent by his assistant, H. J. Gallagher, a Hawaiian sugar planter, who came to the Philippines some five years ago, and who is still in charge of the farm.

In the early history of the Bureau of Agriculture it was planned to replace the antiquated sugar mill on this farm with a modern, up-to-date outfit and make it an object lesson in sugar milling in the Philippines. Before this was accomplished, however, the work animals used on the sugar plantations throughout the Islands, especially in Negros, had died from rinderpest and surra to such an extent, also the price of sugar fell so low, that it was decided that before encouraging the people to engage in the extensive production of sugar, a constant and reliable market should be found for it.

An attempt was made to secure a reduction or abolition of the Dingley Tariff on Philippine sugar entering the United States, as a substitute for the former Spanish market enjoyed by the sugar produced in the Philippines. This question has now been under consideration by the United States Congress for more than two years and there seems no hope for immediate relief in this direction. It has, therefore, been planned by the Bureau of Agriculture to discontinue the production of sugar on a commercial scale at this farm and devote the work to plat experiments dealing with the comparative merits of varieties, value of fertilizers, yield tests, irrigation, diseases, and injuries. A small portion of the farm will also be set aside for general experiments with Philippine Agricultural products, such as abacá, maguey, corn, sweet potatoes, forage crops, and especially leguminous plants to be used as rotation crops in connection with sugar growing. This work will be pushed right through from the beginning by planting native beans and other tropical legumes between the rows of second and third rattoons which do not promise to give a sufficient yield of cane to justify harvesting. The scrub cane which grows upon the land will serve as a trellis on which the beans can run.

There is a small grove of Ceara rubber trees on the place at the present time which is producing an abundance of seed used for distribution by this Bureau. The planting of abacá in the ravines, along the streams through the farm, and also on the level lands in check rows for the

PLATE IV.

PLATE V.

purpose of rotation experiments will be continued. A large lot of native maguey plants are grown there in a nursery for distribution in Negros. The Bureau is also producing there a large lot of kapok trees, a part of which will be planted on the farm and the remainder distributed to persons on that island who may desire them.

Whenever it may be desirable to operate any additional stationary farm machinery on this place the sugar mill can be moved away from the present site, a line shaft put in the mill shed so as to be belted from the water wheel now used to run the sugar mill, then all machinery can be belted from this line shaft.

As soon as we have enough maguey there to justify it, a small maguey-cleaning machine will be sent to this farm.

NOTES FROM FEBRUARY CROP REPORTS OF THE VARIOUS PROVINCES.

ALBAY.

Bato.—Condition of abacá and coconuts is good, that of rice is fair, while that of corn is very poor. Some rice and abacá have been harvested during the month. Due to high water in the river, corn has been injured considerably.

Jovellar.—Condition of growing crops is fair. Twelve thousand coconuts have been gathered during the month. Crops have been injured a little by drought and winds.

Malilipot.—The condition of rice is rather poor, that of abacá, coconuts, sugar cane, and cacao good, while that of corn is excellent. There has been considerable harvesting and planting done in this vicinity during the past month.

Pandan.—Condition of rice is poor, that of the other crops is good. Some of the rice while green has been destroyed by rats. One hundred and fifty hectares of abacá have been harvested during the month.

Polangui.—Condition of abacá is very good, while that of rice is about the average. Two hundred hectares of rice have been harvested during the past month.

Tabaco.—A considerable area has been planted in abacá and coconuts during the month. Condition of growing crops is fair. Camotes and other vegetables have been injured by excessive rains.

Tiwi.—Abaca, which is the only crop under cultivation at this time of the year, is doing well. A number of hectares of same have been harvested during the month.

Virac.—Most of the crops in this municipality are doing well. About 10,000 coconuts have been gathered during the month. Twenty hectares of rice have been harvested.

AMBOS CAMARINES.

Baao.—Considerable rice, coconuts, sugar cane, and cacao have been harvested during the past month. All growing crops are in good condition.

Bato.—The only crop now under cultivation in this municipality is corn. Condition of same is fair.

Buhi.—Condition of crops is fair. Rice, abacá, and coconuts have been harvested during the month.

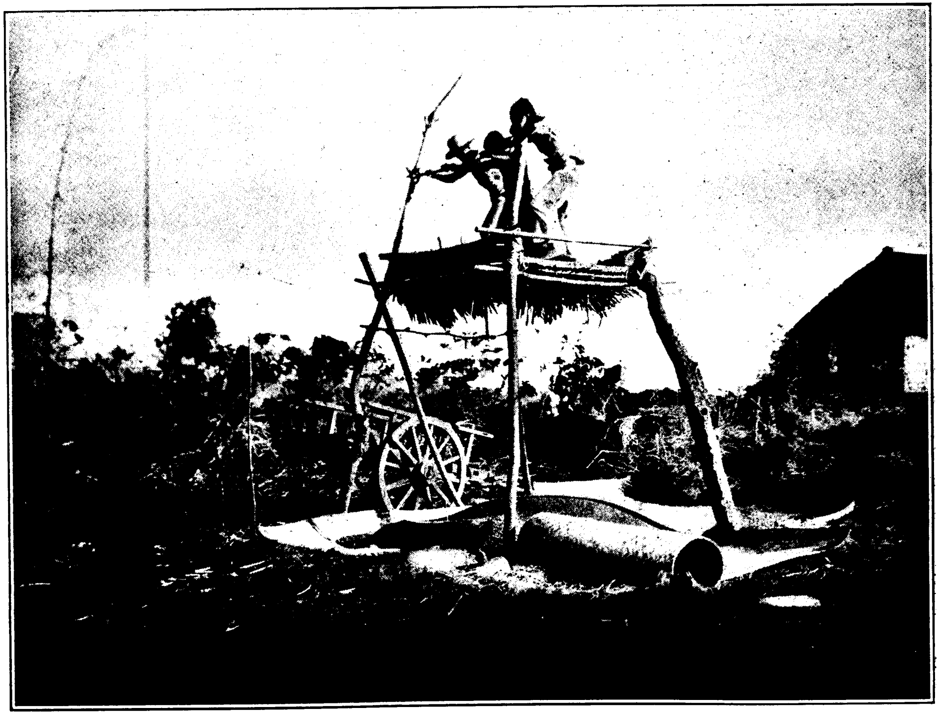


PLATE VI.

Indan.—The condition of the only crop in cultivation at the present time, which is rice, is rather poor. Rats, frogs, lizards, and snakes have damaged same considerably.

Labo.—Condition of crops is fairly good. Four thousand coconuts have been harvested during the month. A little rice and abacá have been planted. Rice and corn have been injured somewhat by the rains.

Lagonoy.—Corn and rice are in good condition. Camotes and corn have been hurt somewhat by excessive rainfall.

Libmanan.—Condition of abacá, coconuts, sugar cane, and corn is fair, while that of rice is poor. There has been a little abacá harvested during the month.

Magaran.—Palay and coconuts are both doing well. There have been 5,500 coconuts gathered during the month. Rice has been damaged somewhat by rats and birds.

Mambulao.—All crops under cultivation are in good condition. Five hundred piculs of coprax have been made during the month.

Pamplona.—Condition of growing sugar is rather below the average, while that of abacá and coconuts is excellent. Corn has been injured by rains.

Paracale.—Condition of abacá is fair. Ten hectares of abacá have been harvested during the month.

Pili.—Condition of abacá, sugar cane, coconuts, and cacao is good. There has been no planting or harvesting done during the month.

San Fernando.—Some 50 hectares of abacá have been harvested during the past month. Condition of both abacá and coconuts is good.

San José.—Field mice and birds have done some damage to crops but not so much as in preceding months. Due to the low prices being paid for hemp and decrease in wages the people are planting camotes and corn to a considerable extent.

Tinambac.—Coconuts and sugar cane are doing well, while the condition of abacá is very good. Camotes have been injured by excessive rainfall.

ANTIQUE.

Culasi.—Some land has been planted in maguey and corn during the past month. The condition of all crops is good.

Dao.—Condition of abacá and coconuts is good. Ten hectares of abacá, 50 hectares of tobacco, and 50 hectares of corn have been harvested during the month. Two hundred coconut trees have been planted.

Laua-an.—All growing crops in this municipality are in good condition. There has been some sugar cane harvested and a few coconuts gathered during the month.

BATAAN.

Abucay.—Condition of sugar cane and corn is fair, while that of rice, coconuts, and cacao is poor. A little sugar cane and corn have been harvested during the month.

BATANGAS.

Cuenca.—Sugar cane and tobacco are in good condition, that of abacá and cacao fair, while coffee is poor. Abacá, sugar, tobacco, corn, and cacao have been harvested during the month.

Ibaan.—Four hundred hectares of sugar cane have been planted during the month. Both sugar cane and corn are in good condition.

Talisay.—Condition of crops now growing in the fields is good. There have been a few hectares of sugar cane, tobacco, and corn harvested during the month.

BENGUET.

Atok.—A number of hectares of rice have been planted and harvested during the month. There have been 143 deaths among hogs; a number of cattle and carabaos have also died.

Baguio.—No crops are being cultivated here at this time of the year outside of rice, which has a local value at the present time of ₱3.50 per cavan in the unhulled state.

Balakbak.—Condition of growing crops is fair. There has been a little harvesting done during the month.

Capangan.—Condition of growing crops is good. A little sugar has been harvested during the month.

Itogon.—Rice is doing fairly well in this municipality. Ten cattle have died of disease during the past month.

Kibungan.—The condition of rice, sugar cane, and coffee is fair. A little of each of these products has been harvested during the month.

Tublay.—The only crop in good condition in this town is sugar cane; all the rest are poor. There has been some coffee and cacao harvested.

BOHOL.

Anda.—There have been 19,470 coconuts gathered this month; some 28 hectares of abacá also have been harvested. Condition of crops good, with the exception of rice, abacá, and corn which are not doing so well.

Antequera.—All of the growing crops are progressing very well. There have been 60 hectares of corn harvested during the month.

Baclayon.—The condition of maguey and coconuts is good, while that of rice is rather poor. Forty thousand coconuts have been gathered this month.

Batuan.—Condition of corn and maguey is below the average, but palay, abacá, and coconuts are doing very well. Four thousand coconuts have been harvested during the month.

Carmen.—Crops under cultivation in this town are doing well with the exception of maguey, the condition of which is rather poor. Ten hectares of abacá have been harvested during the month.

Corella.—Condition of sugar cane and corn is fair, while that of all the rest of the crops is very good. Corn has been injured to a certain extent by locusts.

Cortes.—Corn and rice have been injured somewhat by rats and locusts; otherwise most of the crops in this municipality are doing fairly well. One hundred hectares of corn have been harvested and 3,000 coconuts gathered. There have been 200 deaths among hogs.

Dimiao.—Condition of most of the crops here is fair. A large number of coconuts have been gathered during the month. Locusts have done some damage to the crops.

Jetafe.—Extensive plantings have been made during the past month. Condition of crops good, with the exception of corn, which is not doing so well.

Jagna.—Condition of all crops is fair, with the exception of corn which is rather below the average. A large number of coconuts have been gathered during the month.

Loboc.—Rice is in good condition. There has been a little sugar cane harvested during the past month.

Maribojoc.—Condition of crops in the vicinity of this municipality is fair. Some of the crops have been injured by locusts.

Panglao.—There have been 10 hectares of corn planted during the month. Fifty hectares of rice have been harvested and 12,500 coconuts gathered.

Sierra-Bullones.—The condition of rice, coconuts, and corn is rather poor. Four hundred hectares of rice have been planted in this municipality during the past month.

Tagbilaran.—In this municipality there have been 18 hectares of corn planted during the month and 5 hectares harvested. Two thousand two hundred and twenty-two coconuts have been gathered. Condition of maguey and coconuts is good, while that of corn is rather poor.

Talibon.—Maguey, coconuts, sugar cane, and tobacco are doing well, while rice, abacá, corn, coffee, and cacao are in rather poor condition. Ten thousand coconuts have been gathered during the past month. Corn has been injured by excessive rains.

BULACAN.

Calumpit.—One hundred hectares of sugar cane and 20 hectares of corn have been harvested during the past month. Condition of rice is good; that of sugar cane and corn is fair.

Meycauayan.—Condition of sugar cane is fair. There has been a small amount of same planted and harvested during the month.

Paombong.—Fifty hectares of rice, 6 hectares of sugar cane, and 20

hectares of corn have been planted this month. Condition of crops is good.

San Miguel.—Tobacco is in good condition. There has been some rice, sugar cane, tobacco, and corn harvested this month.

CAGAYAN.

Gattaran.—Condition of crops in this municipality is fair. There have been harvested during the month 200 hectares of rice and 80 hectares of corn.

Sanchez-Mira.—Condition of all growing crops is good. There has been a small amount of coconuts gathered during the month.

Solana.—Condition of rice, sugar cane, abacá, and corn is good. One hundred hectares of rice and 100 hectares of corn have been harvested during the month.

Tuao.—Condition of tobacco crops is good, there being about 50 hectares of same under cultivation at this time.

CAPIZ.

Ivisan.—The condition of maguey, coconuts, and corn is good, while that of abacá is fair. Four hectares of sugar cane have been harvested and 2,000 coconuts gathered during the month. Tobacco has been injured somewhat by excessive rain.

Libacao.—Condition of abacá is fair. There have been 2,000 coconuts gathered during the month. Due to high water in the river abacá has been injured to some extent.

Looc.—Condition of corn is fair. The principal crops in this municipality are coconuts, abacá, tobacco, corn, and rice.

Odiongan.—Condition of abacá, coconuts, and sugar cane is very good, while that of maguey, tobacco, corn, and coffee is fair. About 100,000 coconuts have been gathered during the month.

Pontevedra.—Condition of coconuts, sugar cane, and cacao is good. No crops have been harvested or planted during the month.

CAVITE.

Carmona.—Rice and sugar cane are doing well, while the condition of corn is fair. A little rice, sugar cane, and corn have been harvested during the month.

Maragondon.—The only crop at present under cultivation is sugar cane. The condition of same is good. One thousand eight hundred piculs of sugar have been harvested during the month.

San Francisco de Malabon.—Condition of sugar cane is fair. There have been 100 hectares of same planted during the month and 50 hectares harvested.

CEBU.

Argao.—Coconuts, sugar cane, and tobacco are doing well. Considerable corn has been harvested during the month. Due to the low price of maguey there is very little being sold at the present time.

Bantayan.—No plantings have been made during the month. Eighty-two hectares of corn have been harvested and a considerable number of coconuts gathered.

Boljo-on.—Condition of crops is not very good. Some 12,000 coconuts have been gathered in the past month. Corn has been injured to a certain extent by drought.

Carmen.—Abacá, coconuts, sugar cane, and cacao are not doing extremely well; the condition of maguey is fair. There have been a number of hectares of abacá, maguey, coconuts, and sugar cane harvested during the month.

Catmon.—The condition of all crops is fair, with the exception of coffee and cacao, which are very poor. Crops have been injured to a slight extent by excessive rain.

Daan Bantayan.—A considerable amount of rice, maguey, coconuts, sugar cane, and corn has been harvested during the month. Condition of all crops is fair. Crops have been injured somewhat by drought.

Dumanjug.—Condition of tobacco is excellent, that of maguey good, that of rice, abacá, and coconuts fair, while that of corn and cacao is poor. A large number of hectares of tobacco and corn have been planted during the month.

Liloan.—Condition of abacá and maguey is fair, while that of coconuts, sugar cane, and tobacco is very good. A number of coconuts have been gathered during the month and abacá, maguey, and sugar cane have been harvested.

Malaboyoc.—Tobacco and corn are doing fairly well. There have been 30,125 coconuts harvested during the month.

Moalbual.—Coconuts to the number of 20,000 have been gathered this month. Condition of abacá, coconuts, sugar cane, and cacao is good, that of maguey fair, while rice, corn, and coffee are rather poor. Rice has been damaged a little by worms.

Opon.—Condition of coconut trees is fair. Due to drought in October and November it is not possible to harvest any corn this season.

Samboan.—A number of coconut trees have been planted during the month. There have been gathered 15,360 nuts. Some corn has also been harvested.

San Fernando.—No crops of any consequence have been planted during the month. Condition of crops is good. Twenty piculs of maguey, 30 piculs of coprax, 100 piculs of sugar, 50 quintals of tobacco, and 500 cavans of rice have been harvested. Crops have been injured to a certain extent by drought.

San Remigio.—Maguey is doing well, while the condition of coconuts, sugar cane, tobacco, and corn is fair. Some coconuts and sugar cane have been harvested during this month.

Sibonga.—Condition of all crops is good. Tobacco is sold here during the months of March, April, June, and July. Crops have been damaged somewhat by drought and winds.

Talisay.—Condition of corn is good, while that of sugar cane is fair. Excessive rainfall has damaged corn and sugar cane somewhat. Fifteen carabaos have died during the month.

Toledo.—Condition of tobacco and corn is fair, while that of the rest of the crops is good. Tobacco has been injured by excessive rainfall.

Tuburan.—Tobacco is in good condition. There have been 1,000 hectares of same planted during the month.

Tudela.—Five hectares of abacá have been harvested and 20,000 coconuts gathered during the past month.

ILOCOS NORTE.

Badoc.—Sugar cane and tobacco and corn are in fair condition. There have been several hectares of each of these crops planted during the past month.

Bangui.—A large amount of rice, maguey, and sugar cane have been harvested during the month. There have been planted 40 hectares of sugar cane and 50 hectares of tobacco. Condition of crops is good, although they have been injured somewhat by drought and wind.

Laoag.—One thousand hectares of maguey, 200 hectares of sugar cane, and 80 hectares of corn have been harvested during the month. Condition of maguey and sugar cane is good, while that of rice and corn is fair.

Paoay.—Considerable land has been planted in maguey, coconuts, sugar cane, tobacco, and corn during the month, the condition of all these crops being good.

Pasuquin.—Maguey and sugar cane harvested during the past month amounted to 40 piculs and 320 piculs, respectively. Condition of crops is fair.

ILOCOS SUR.

Bangued.—There have been harvested during the past month in this town 300 hectares of sugar cane, 15 hectares of tobacco, and 15 hectares of corn. Condition of coconuts, sugar cane, and corn is very good, while that of maguey and tobacco is fair; coffee and cacao are below the average. Excessive rains have damaged some of the crops to a certain extent.

Bucay.—Condition of sugar cane and corn is poor. Cacao has been

injured by insects somewhat. Rinderpest still continues but the Bureau is doing its best to stamp out the disease.

Cabugao.—All growing crops are in good condition. Maguey is being held for a better price, the price offered for it at the present time being very low.

Dolores.—Condition of coconuts is good, that of other crops being only fair. Five hectares of corn and 14 hectares of sugar cane have been harvested this month.

La Paz.—A number of hectares of sugar cane and corn have been harvested during the past month. Condition of growing crops is good.

Magsingal.—Considerable maguey and sugar cane have been harvested during the month. Quite a number of hectares of maguey and tobacco have been planted.

Narvacan.—Condition of all growing crops is good. Considerable sugar cane and maguey have been harvested during the month. There has been considerable disease among animals.

Pilar.—Condition of crops now under cultivation is good. A little sugar cane, tobacco and corn have been planted during the past month.

Santa Cruz.—The condition of maguey, sugar cane, and corn is good; that of coconuts being fair. One hundred hectares of sugar have been planted during the month and 150 hectares harvested.

Santa Lucia.—The condition of all crops in this municipality is good, with the exception of cacao which is not doing quite so well. Sugar cane, tobacco, and corn have been planted during the month. There have been a number of hectares of maguey, sugar cane, and corn harvested.

Vigan.—On account of lack of rain the sugar-cane crop has been short this year. Condition of corn and sugar cane is poor, while that of maguey is good.

ILOILO.

Banate.—Most of the crops are doing well, with the exception of abacá and maguey, the condition of which is not so good. No plantings of any consequence have been made during the month.

Guimbal.—Ten thousand five hundred coconuts have been gathered during the past month. Rats have damaged sugar cane to some extent.

Leon.—Plantings of sugar cane, tobacco, and corn have been made during the past month. Condition of corn is good, while that of sugar cane and tobacco is excellent.

Miagao.—Condition of growing crops is good. One hundred hectares of sugar cane and 100 hectares of corn have been planted during the month.

Tigbauan.—Condition of abacá, coconuts, and tobacco is good, while that of corn is fair. No crops have been harvested or planted during the month.

ISABELA.

Gamu.—Sugar cane and tobacco are in good condition. Plantings of these crops have been made to some extent during the month.

Tumauini.—There has been considerable abacá planted and harvested here during the past month. It has been injured somewhat by worms; condition of same is fair.

LA LAGUNA.

Biñan.—Four hundred hectares of rice and 15 hectares of sugar cane have been harvested during this month. Condition of crops is fair.

Calamba.—All crops are doing well. A few hectares of sugar cane and corn have been planted during the month. About 250 piculs of sugar cane and 250 cavans of corn have been harvested.

Pangil.—Five thousand hectares of rice have been planted during the month. Condition of same is good.

San Pablo.—Abacá, tobacco, and corn have been planted during the past month. Condition of crops is good.

LA UNION.

Bacnotan.—Coconuts to the number of 4,000 have been gathered during the month. Condition of coconuts and tobacco is good, while that of maguey, sugar cane, corn, coffee, and cacao is fair.

Bangar.—All crops are doing well with the exception of sugar cane, corn, and tobacco, the condition of which is rather below the average. There has been a small amount of maguey, coconuts, sugar cane, and corn harvested during the month.

LEPANTO-BONTOC.

Angaqui.—Condition of crops is good. Seed rice is being prepared for planting in the fields.

Sabangan.—The only crop now under cultivation at the present time in this municipality is rice, the condition of which is fair.

San Emilio.—Crops are doing well here, with the exception of coffee and cacao. Mongos, camotes, tobacco, and corn have been planted during the month.

Santol.—Ten hectares of tobacco have been harvested here during the month. This and sugar cane are the two principal crops grown in the vicinity.

Sudipen.—Camotes and corn have been injured by drought. Very few crops are being cultivated here at this time of the year.

Suyo.—A small amount of sugar cane has been harvested and a few hectares of corn planted during the month. Crops are in good condition.

LEYTE.

Cabalian.—Coconuts to the number of 100,000 were gathered during the past month. Condition of growing crops is fair. Crops have been injured to some extent by excessive rains.

Jaro.—In this municipality there have been 220 hectares of rice, 520 hectares of abacá, 100 hectares of coconuts, 30 hectares of tobacco, and 50 hectares of corn planted during the month. The condition of the first two mentioned crops is good, but that of the last three named is rather below the average. There have been 160 hectares of abacá and 50 hectares of coconuts harvested.

Kauayan.—With the exception of corn the condition of all growing crops is excellent. Seventy-six hectares of abacá have been harvested and 224,700 coconuts have been gathered during the month.

Matalom.—Condition of abacá, coconuts, tobacco, and corn, which are the only crops under cultivation at this time of the year, is fair. Eighty-five carabaos and 10 cattle have died during the month.

Tacloban.—Condition of growing crops is fair. There have been 300,500 coconuts gathered and 10 hectares of abacá harvested during the month. The health of all animals in this municipality is good.

MISAMIS.

Langaran.—The condition of corn is poor, that of coconuts and sugar cane fair, while that of abacá is very good. Eighty thousand nuts have been gathered and 25 hectares of abacá harvested during the month.

MORO.

Lamitan.—Crops now under cultivation here are abacá, coconuts, and coffee. The condition of all is good. There have been excessive rains during the month which will delay the planting of upland rice, the ground being too wet to plow.

NUEVA ECIJA.

Aliaga.—The only crops at present under cultivation in this municipality are sugar cane, tobacco, and corn. Condition of all of these crops is good.

Bongabong.—A small amount of sugar cane has been planted and harvested during the past month. Coconuts, sugar cane, and tobacco are in good condition.

Carranglan.—All crops now under cultivation are doing very well. The principal crops in this municipality are rice, corn, tobacco, sugar cane, and coffee.

Gapan.—Condition of growing crops is good. One hundred and twenty hectares of sugar cane, 150 hectares of tobacco, and 50 hectares of corn have been harvested during the past month.

Pantabangan.—Sugar cane and coffee are both in good condition. Insects have injured tobacco to some extent.

Peñaranda.—All crops now under cultivation are doing fairly well. There have been a few deaths among carabaos from disease. About 25 hectares of corn have been planted during the month.

San Jose.—Condition of all crops is rather poor. A little sugar cane has been planted and harvested during the month. Corn has been damaged by drought.

San Juan de Guimba.—Condition of rice is fair, while that of other crops is good.

NEGROS OCCIDENTAL.

Cadiz.—All crops are in very good condition. About 100,000 coconuts have been gathered during the month. There have been 200 hectares of abacá, 300 hectares of sugar, and 500 hectares of corn harvested.

Isabela.—Two hundred hectares of sugar cane have been planted and 500 hectares harvested during the past month. Abacá and sugar cane are in excellent condition.

Manapla.—Abacá and coconuts are doing well, condition of sugar cane being fair, and that of corn poor. Thirty hectares of abacá, 1,000 hectares of sugar cane, and 200 hectares of corn have been harvested this month.

Saravia.—About 25 hectares of sugar cane have been planted. Condition of crops is fair. Two hundred hectares of sugar cane, yielding 4,000 piculs of sugar, have been harvested during the month. A number of carabaos and cattle have died here recently.

NEGROS ORIENTAL.

Bais.—Condition of crops is good. Abacá, sugar cane, and corn have been planted during the month. There has also been considerable abacá sugar cane, and coconuts harvested.

Dauin.—There have been 25 hectares of abacá, 33 hectares of tobacco and 4 hectares of corn harvested during the past month; 24,000 coconuts have been gathered. Condition of crops is fair.

Larena.—The condition of most of the growing crops is fair. Disease has killed 261 hogs during the month.

Lazi.—Condition of rice and coconuts is poor, while that of tobacco is fair. Some abacá, coconuts, and corn have been harvested during the month.

Luzuriaga.—Crops which are now under cultivation are doing well. There have been 1,113 piculs of abacá and 45 piculs of coprax produced during the past month.

Siaton.—Harvesting of abacá and coconuts is now going on. Hogs to the number of 150 have died during the month.

Tanjay.—The condition of growing crops here is fair. There have

been 270 cavans of rice, 12 piculs of abacá, 30 piculs of coprax, 600 piculs of sugar, and 300 cavans of corn produced during the past month.

Tolong.—There have been 10 hectares of abacá, 4 hectares of sugar cane, and 180 hectares of corn harvested during the month. The condition of growing crops is very good.

PAMPANGA.

Arayat.—Condition of sugar cane and corn is fair. No planting or harvesting has been done during the past month.

Candaba.—Three hundred hectares of palay, 100 hectares of sugar cane, and 40 hectares of corn have been planted this month. Condition of all growing crops is fair.

Macabebe.—The only crop at present under cultivation in this municipality is rice; condition of same is good.

Magalan.—Condition of growing crops in this district is good. Sugar cane has suffered a loss of about 30 per cent due to an earthquake a short time ago in that locality. Rice has also suffered somewhat on account of high water in the river.

Porac.—Grinding of sugar cane and thrashing of rice is now going on in this municipality. All crops are in good condition.

PANGASINAN.

Agno.—Sugar cane is in good condition. One thousand hectares of same have been planted during the month.

Alaminos.—All crops are in good condition. There has been a small amount of maguey, coconuts, and sugar cane harvested during the past month.

Alcala.—The condition of sugar cane and corn is about up to the average. Two hundred hectares of corn have been harvested during the month. Crops have been injured to a certain extent on account of lack of rain.

Bani.—Condition of sugar cane is good. Five hectares of same have been planted and 4 hectares harvested during the month.

Bolinao.—Four hectares of sugar cane and 2 hectares of tobacco have been planted in this municipality during the past month. The condition of these crops and also that of maguey is good. Three hundred piculs of maguey and 500 piculs of coprax have been harvested. There have been a number of deaths among animals of late.

Calasiao.—Condition of corn, coffee, and cacao is fair, while that of sugar cane is good. Fourteen thousand coconuts have been gathered during the month.

Mangaldan.—Some five hectares of sugar cane have been planted during the month. Ten thousand coconuts have been harvested; also some sugar cane, tobacco, and corn. Drought has retarded the growth of some of the crops.

Mangatarem.—Ten thousand coconuts have been gathered and 1,415 hectares of rice have been harvested during the past month. Condition of crops is fair.

Natividad.—All crops are in good condition, with the exception of rice, abacá, maguey, and cacao which are fair. A number of animals have died of disease during the month.

Pozorrubio.—Condition of rice is rather poor. Some crops have been injured by drought.

San Carlos.—Condition of growing crops in this municipality is fair. One hundred hogs have died during the month.

San Fabian.—Condition of growing crops is good. There have been gathered during the month about 21,000 coconuts; there has also been a little sugar cane, tobacco, and corn harvested.

San Nicolas.—All crops in this town are doing rather poorly. A number of hectares of sugar cane and corn have been harvested during the month. Crops have been injured somewhat by drought.

Santa Barbara.—Condition of tobacco is poor, that of corn fair, while coconuts and sugar cane are doing very well. Some coconuts, sugar cane, tobacco, and corn have been harvested during the month.

Urbiztondo.—Condition of all growing crops is good. Deaths among hogs and goats have numbered 250 and 150, respectively, during the past month.

RIZAL.

Mariquina.—Condition of sugar cane and corn is fair. No harvesting or planting has been done during the month.

Navotas.—The only crop at present under cultivation in this municipality is rice; the condition of same is good.

Pasig.—Condition of sugar cane is good. One hundred hectares of this crop have been harvested during the month; also 20 hectares of corn.

Pililla.—Condition of growing crops is rather below the average. A little harvesting has been done during the past month.

San Felipe Neri.—Zacate, which is one of the principal products in this municipality, is in poor condition on account of drought.

SAMAR.

Basey.—Coconuts to the number of 99,000 have been gathered during the past month. Condition of both coconuts and abacá is good.

Bobon.—Forty-five hectares of rice have been planted this month; condition of same is good.

Guiuan.—Condition of all growing crops is good. There have been 206,250 coconuts gathered during the month.

Lavezares.—Rice has been damaged by insects and rats. Heavy rains have also tended to cause some injury.

Palapag.—Rice, tobacco, and corn are doing poorly; abacá is a little

better and the condition of coconuts is about the average. Forty-five hectares of tobacco have been harvested during the month. Some 20 hectares of rice have been injured by an insect called "gota."

San Antonio.—A number of hectares of rice, abacá, and tobacco have been harvested during the past month. Condition of tobacco is fair, that of abacá and coconuts good, while that of rice is excellent.

Tarangnan.—Corn and tobacco have been injured by excessive rainfall. Rice has been damaged somewhat by locusts. Most of the crops in this municipality are in rather poor condition.

SORSOGON.

Bacon.—Some damage has been done to rice by insects and worms. Condition of rice and abacá is poor. There is considerable suffering here on account of the low price which abacá commands in the market at present, while the price of rice, the principal food of the people, is steadily advancing. The majority of the people here are living on bananas, camotes, and roots.

Bulan.—Condition of growing crops is poor. Production of all crops is below that of last year.

Bulusan.—All crops are doing well with the exception of rice, coconuts, sugar cane, and cacao, the condition of these not being so good. Rice has been injured to a certain extent by insects.

Dimas-Alang.—No plantings have been made in this municipality during the month. Condition of growing crops is below the average. A small amount of tobacco has been harvested.

Gubat.—Considerable damage has been done to the rice crop during the month by rats. Ten thousand coconuts and 300 hectares of abacá have been harvested during the month.

Magallanes.—Crops at present under cultivation in this municipality are abacá, maguey, coconuts, and sugar cane. They are all doing well.

Milagros.—Condition of coconuts is good. Three thousand nuts have been harvested during the past month.

San Pascual.—Condition of growing crops is good. Corn, tobacco, coconuts, bananas, and camotes are the principal products in this locality.

SURIGAO.

Gigaquit.—Condition of growing crops in this town is good. No plantings have been made during the month.

TARLAC.

Bamban.—Growing crops are in fair condition. There has been considerable sugar cane planted and harvested during the month.

Capas.—Condition of coconuts, sugar cane, and tobacco is good. Very little harvesting or planting has been done during the past month.

La Paz.—Condition of sugar cane is very good, while that of tobacco and corn is fair. Thrashing of rice is now going on in this municipality.

Victoria.—Condition of corn is below the average, while that of sugar cane and tobacco is good. Lack of rain has caused damage to some of the crops.

TAYABAS.

Infanta.—The condition of both rice and coconuts is good, while that of abacá is excellent. Coconuts to the number of 40,000 have been gathered during the past month.

Mulanay.—Fifteen thousand coconuts have been gathered during the month. Ten cattle have died of disease.

ZAMBALES.

Iba.—Report from this municipality indicates that condition of crops is rather poor. There have been several hectares of sugar cane and corn planted during the month.

Masinloc.—Condition of growing crops is poor. There has been a little sugar cane and corn harvested and planted during the past month.

San Marcelino.—There has been some sugar cane and corn planted during the month. There is not so much disease among animals here as formerly.

San Narciso.—There have been 23 deaths from rinderpest among carabaos during the past month. Condition of growing crops is good.

RANGE OF PRICES OF PHILIPPINE AGRICULTURAL PRODUCTS.

Lowest, highest, and average prices of palay, abacá, copra, sugar, tobacco, and corn for the month of February, 1908.

Province.	Palay, per cavan.			Abacá, per picul.			Copra, per picul.		
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.
Albay	₱2.25	₱3.00	₱2.62	₱6.25	₱8.50	₱7.37	₱4.00	₱7.00	₱5.50
Ambos Camarines	2.50	3.00	2.75	4.00	9.37	6.68	4.00	7.00	5.50
Antique	2.50	3.12	2.81	18.00	30.00	24.00			
Bataan	2.50	2.50	2.50						
Batangas	2.50	2.50	2.50	22.00	22.00	22.00			
Benguet	3.50	4.00	3.75						
Bohol	2.00	3.50	2.75	12.00	23.00	17.50	5.50	8.00	6.75
Bulacan	2.25	2.80	2.52						
Cagayan	3.00	3.75	3.37						
Capiz	2.00	3.12	2.56	13.00	25.00	19.00	5.00	8.00	6.50
Cavite	2.60	2.75	2.67						
Cebu	2.30	2.50	2.40	6.00	25.00	15.50	3.00	12.50	7.75
Ilocos Norte	2.50	3.50	3.00						
Ilocos Sur	3.12	4.00	3.56						
Iloilo	2.50	2.75	2.62	8.00	30.00	19.00	6.00	9.00	7.50
La Laguna	2.00	3.10	2.55	8.60	19.00	13.80	5.00	5.00	5.00
La Union	2.75	3.62	3.18				5.00	9.00	7.00
Lepanto-Bontoc	3.00	3.75	3.37						
Leyte	3.00	4.00	3.50	7.00	18.00	12.50	4.00	8.00	6.00
Misamis	3.10	3.10	3.10	9.50	9.50	9.50	6.50	6.50	6.50
Moro	2.50	2.50	2.50						
Nueva Ecija	1.25	2.75	2.00				10.00	10.00	10.00
Occidental Negros	2.50	3.00	2.75	17.00	28.00	22.50	6.50	10.00	8.25
Oriental Negros	2.00	4.00	3.00	4.00	12.00	8.00	6.00	6.50	6.25
Pampanga	2.50	2.80	2.65						
Pangasinan	2.50	3.50	3.00				6.50	10.00	8.25
Rizal	2.50	3.00	2.75						
Romblon	3.00	3.75	3.37	14.00	20.00	17.00	4.00	6.68	5.34
Samar	3.00	3.75	3.37	12.00	15.00	13.50	5.10	7.00	6.05
Sorsogon	3.50	3.50	3.50	8.00	19.00	13.50	5.50	7.00	6.25
Tarlac	2.00	2.40	2.20						
Tayabas	2.50	4.00	3.25	6.00	8.00	7.00	3.75	6.00	4.87
Zambales	2.50	2.50	2.50						

Province.	Sugar cane, per picul.			Tobacco, per quintal.			Corn, per cavan.		
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.
Albay				₱30.00	₱30.00	₱30.00	₱1.25	₱5.00	₱3.12
Ambos Camarines							1.50	1.50	1.50
Antique	₱3.00	₱3.00	₱3.00				3.12	3.12	3.12
Bataan							1.50	1.50	1.50
Batangas	2.00	4.50	8.25	3.50	10.00	6.75	1.28	2.50	1.89
Bohol	3.50	4.00	3.75	9.50	15.00	12.25	1.00	3.50	2.25
Bulacan	3.00	3.00	3.00				2.00	2.00	2.00
Cagayan							1.25	3.00	2.12
Capiz	3.00	4.00	3.50	18.00	18.00	18.00	1.40	1.50	1.45
Cavite	3.25	3.70	3.47						
Cebu	2.50	4.00	3.25	4.00	25.00	14.50	1.80	3.50	2.65
Ilocos Norte	3.00	4.00	3.50	10.00	19.00	14.50	1.50	4.00	2.75
Ilocos Sur	2.50	4.00	3.25	3.00	5.00	4.00	2.50	4.00	3.25
Iloilo	3.00	4.50	3.75	20.00	22.00	21.00	2.50	3.00	2.75
La Laguna	3.50	4.00	3.75				2.50	2.80	2.65
La Union	2.50	2.60	2.55				2.00	2.00	2.00
Lepanto-Bontoc	2.50	2.50	2.50	4.00	4.75	4.37	5.75	5.75	5.75
Leyte	3.50	3.50	3.50	10.00	25.00	17.50	2.50	3.25	2.87
Misamis							3.50	3.50	3.50
Nueva Ecija				2.00	12.00	7.00	2.00	2.00	2.00
Occidental Negros	2.50	4.20	3.35				2.00	2.75	2.37
Oriental Negros	3.50	4.00	3.75	6.00	7.50	6.75	2.50	4.00	3.25
Pampanga	3.00	3.80	3.40						
Pangasinan	2.00	3.10	2.55	2.00	33.00	17.50	1.50	4.00	2.75
Romblon				4.00	5.00	4.50	2.00	2.00	2.00
Samar							1.00	1.00	1.00
Sorsogon	3.00	3.00	3.00						
Tarlac	3.20	3.50	3.35	8.00	8.00	8.00	1.75	2.50	2.12
Tayabas							2.50	2.50	2.50

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Bureau of Agriculture.

SEED AND PLANT DISTRIBUTION.

MAGUEY PLANTS.

For the guidance of those wishing to secure maguey plants from the Bureau of Agriculture the following statement is issued:

PLANTS FOR DISTRIBUTION.

The Bureau has ordered from Hawaii, with the promise of delivery in June, July, and August, 1,000,000 pole plants and 500,000 sucker plants.

The 60,000 nursery plants growing at Singalong will be ready for delivery in June and the 350,000 native nursery plants growing at Lamao will be ready for delivery in September and October.

DISTRIBUTION.

These plants will be distributed free of charge to parties requesting them, for their own use, as follows:

500 Hawaiian pole plants, or
200 Hawaiian sucker plants, or
400 Native nursery plants.

No free distribution will be made of over 500 plants to one person.

Parties wishing larger quantities will be required to pay for them at the following rates:

	Per 1,000
Hawaiian pole plants, - - - -	₱6.00
Hawaiian sucker plants, - - -	18.00
Hawaiian nursery plants, - - -	20.00
Native nursery plants, - - - -	6.00

Hawaiian nursery plants will not be sold in lots of over ten thousand to one person.

Parties ordering plants not on the free list should send post-office money order for amount of purchase.

Literature on the subject of maguey growing in the Philippine Islands can be secured from the Bureau of Agriculture.

G. E. NESOM, Director of Agriculture.

THE PHILIPPINE

Agricultural Review

VOL. I MAY, 1908 No. 5

CONTENTS AND ILLUSTRATIONS.

CONTENTS.

ILLUSTRATIONS.

EDITORIAL.

ANIMAL DISEASES AGAIN.

The reader has no doubt observed that our March number was devoted entirely to a popular catechism dealing with the leading infective animal diseases prevailing in the Philippines. Since that number was prepared definite action has been taken looking toward the exclusion of animals suffering from these diseases and regulating the movement of diseased cattle within the Islands more effectually than has ever been done heretofore.

The enforcement of Act No. 1760 so as to prevent the further introduction and spread of infective animal diseases in the Philippine Islands marks an epoch in the history of agriculture in this Archipelago under the American occupation.

As showing the action taken, we are publishing in this number of the REVIEW General Order No. 10, which was issued just after the completion of the manuscript for this number, but which has been here included.

We are also publishing in this number an article prepared by the Director of Agriculture giving a general view of the animal-disease problem in the Philippines, and a report on animal industry in Indo-China, prepared by Dr. C. G. Thomson, who was sent there as a representative of the Government of the Philippine Islands to investigate this subject.

As an indication of the further steps which are being taken to protect the animals of the Philippine Islands against future invasions of infective diseases, it is of interest to note that the Philippine Legislature made a special appropriation of ₱100,000, in addition to the regular current annual appropriation of the Bureau of Agriculture, to be devoted to the suppression of such diseases. Subsequently they appropriated the sum of ₱150,000 for the purchase of land to be used as a site for a live-stock depot and quarantine station in the city of Manila and to fill and construct streets, drains, etc., necessary to put this land in a satisfactory condition to be used for the desired purpose. They also appropriated ₱85,000 in the public works budget to be used for the construction of the necessary buildings and sheds in this station.

The entire serum herd heretofore kept at the San Lazaro Hospital grounds in the city of Manila is to be removed in the near future to a special farm located outside of the city of Manila and on which the buildings, roads, and water supply are being constructed and abundant pasturage and meadows provided for keeping a larger herd and under more favorable conditions than have heretofore prevailed.

The laboratory is a modern reënforced-concrete building constructed on up-to-date sanitary lines and designed especially for this work. All of the other buildings are designed after types worked out for use in the tropics by long experience here and elsewhere.

With all these activities, conditions, and facilities the people of the Archipelago are assured that positive and effective measures are being adopted to accomplish that greatly desired end—placing infective animal diseases under control and restoring to the people an abundant supply of work animals, thereby insuring the future prosperity of the agriculture of these Islands.

BUD ROT OF THE COCONUT.

The coconut crop of the Philippine Islands is one of considerable importance, as shown by the fact that the exports of copra and oil for the past nine years have been as follows:

Year.	Copra.	Oil.	Year.	Copra.	Oil.
1899	₱1,313,740		1904	₱5,054,038	
1900	3,381,794		1905	4,190,704	
1901	5,296,610		1906	8,086,230	₱79,166
1902	2,003,312		1907	8,106,386	101,166
1903	8,945,358				

As will be seen from the above table, it is only during the past two years that coconut oil has constituted an export of any consequence from these Islands.

The section of the Islands where the coconut industry is of most importance is in southern Luzon and the Visayas. The natural habitat of the coconut is along the sandy stretches adjoining the coast and near sea level, but the industry has spread from the Tayabas coast over the tops of the mountains and in places to Laguna de Bay. There are many places in the Islands where coconuts have been planted well back into the hills and mountains. They grow at altitudes up to 3,000 feet. Many persons on passing steamers have admired the beautiful coconut groves on the mountain sides of Romblon.

But when the coconut is taken very far away from the seacoast to higher elevations, it is more or less out of its natural habitat and does not resist diseases and enemies as readily as it does near the sea, and so falls a prey to the ravages of such infections as bud rot.

This disease at present affects only the coconuts of higher altitudes and over a small area, but it is likely to spread to the groves near the coasts and result in serious damage to the coconut industry.

It is with a view to disseminating information regarding this disease and warning the people to guard against it that we are publishing the article and report by Professor Copeland on bud rot of the coconut in the Provinces of Tayabas and La Laguna.

THE ANIMAL-DISEASE PROBLEM.

By THE DIRECTOR OF AGRICULTURE.

It is a generally accepted statement that prosperity in the Philippine Islands is directly dependent on an abundant supply of work animals for tilling the soil. There is a firm belief among many who have made a study of the question that agricultural industries in these Islands have suffered more as a result of animal diseases during the last twenty years than from all other causes.

This belief is well-grounded, as shown by the fact that in order to meet the needs of the people in the way of food, rice has been imported as follows:

Year.	Value.	Year.	Value.
1900	₱6,226,846	1904	₱23,097,628
1901	10,981,916	1905	14,913,476
1902	13,156,962	1906	8,751,000
1903	20,122,646	1907	7,324,986

The following table shows the importations of cattle during the same period:

Year.	Number.	Value.	Year.	Number.	Value.
1900	4,555	₱258,352	1904	35,828	₱1,669,120
1901	2,266	147,680	1905	30,256	1,545,624
1902	15,435	963,692	1906	30,729	1,656,412
1903	29,783	1,457,636	1907	38,300	2,117,648

While the rice imports increased up to 1904 and then rapidly decreased for two years, it is interesting to note that the imports for 1907 were almost as large as for 1906. The short crops of last year harvested at the beginning of 1908 will probably result in making the imports of rice during this year even greater than those for 1906 and 1907.

On the other hand, the cattle imports remained practically stationary from 1902 to 1906, and then suddenly increased over 20 per cent in number and half a million pesos in value. The first thought is that this increase consists largely of animals destined for the farms, or for draft purposes, but an examination of the figures shows that such is not the case.

The cattle imports arriving in Manila for the twelve months ending April 30, 1908, were as follows:

Port.	Number of shipments.	Number of cattle.	Port.	Number of shipments.	Number of cattle.
Hongkong	364	23,034	Vinh	2	1,028
Phuyen	9	6,566	Quin Hone	2	387
Pnom Penh	7	4,240	Hai How	1	376
Kam Ranh	7	1,826			
Saigon	6	1,066	Total	398	38,423

The following table shows the disposition of these cattle:

Slaughtered for sale in the city of Manila	25,406
Shipped to the provinces on certificates of inspection	9,930
On hand, died in corrals, and otherwise disposed of	3,087
Total	38,423

The first item of this table is the actual record taken from the Manila slaughterhouse, and, in passing, it may be noted that these 25,406 head of cattle produced 6,408,928 pounds of meat, worth about ₱1,280,000. The average weight of each carcass was 252 pounds and their average value as dressed beef ₱50.30.

Of those shipped to the provinces it is estimated that approximately 80 per cent, or nearly 8,000, were slaughtered in the larger towns near Manila and that not more than 2,000 ultimately reached the farms for draft purposes.

During this same twelve-month period there were received in Manila 1,492 head of carabaos from foreign ports and 1,183 from interisland ports. While some of these died and a small percentage were sold for draft purposes in the city of Manila, it is estimated that approximately 2,000 of them were shipped to the provinces for draft purposes. This gives a total of 4,000 head of draft cattle of both classes that reached the provinces through the port of Manila, or about 10 per cent of the total importations.

The third item includes all shortages in shipments by virtue of deaths en route, which were not counted, and of which there are many under the poor shipping facilities used in bringing cattle to the Philippines, 693 deaths in the corrals after arrival here, and a considerable number of animals sold for draft purposes in the city of Manila. It is probable that some of the latter were sold outside of the city limits and went to the provinces, either for slaughter or for draft purposes.

Another question of considerable interest in connection with these cattle is their condition on arrival in the Philippine Islands.

Of the shipments arriving from Hongkong, 121, or 33 per cent, were infected with rinderpest, and 55, or 15 per cent, with foot-and-mouth disease, and two shipments with anthrax.

It does not seem entirely clear from the census tables, but the total number of cattle in the Islands evidently refers to the number at the time the census was taken, while the total deaths cover a period of possibly a year preceding that time, hence at least a part of those reported to have died were cattle on hand during that year.

It is interesting to note the enormous death rate among live stock in the Islands at that time. Then surra, rinderpest, foot-and-mouth disease, and hæmorrhagic septicæmia were raging throughout the Archipelago. Since that time no census has been taken and the statistical reports from the municipalities to the Bureau of Agriculture are neither complete nor entirely accurate, but from such statistics as are available it is estimated that there are in the Islands at the present time about 560,000 head of carabaos and 235,000 cattle, making a total of 795,000 head. The statistics on the number of deaths occurring from infective diseases are still less accurate and reliable, but it is safe to say that the death rate now is not more than 5 per cent of what it was when the census of 1903 was taken, or approximately 30,000 head per annum.

Taking the number of animals which passed through the port of Manila going to the provinces for work purposes as compared with the total number of animals which died from infective diseases in the provinces, it may be readily seen that for every imported animal so shipped for work purposes there were ten deaths from infective diseases. This clearly indicates that the imported animal which is not carefully guarded against taking infective diseases to the provinces has been one of the greatest sources of contagion which has continued to prevent the suppression of animal diseases.

There are enough cattle here to re-stock the Islands in a very few years if they were protected and allowed to breed freely, but if infective diseases continue to devastate them the probabilities are entirely against the restoration of work animals in such numbers as to permit the cultivation of the farms as they were twenty years ago, within a period which the average person would be willing to wait for such results.

The conclusion is therefore forced upon the people of these Islands that the only satisfactory means of obtaining a sufficient supply of work animals is to protect the native cattle and carabaos and permit them to re-stock the Islands by the natural process of breeding. This theory is amply supported by the experience of many sections where diseases have not been prevalent. The Island of Cebuyan, the Province of Palawan, Cagayan Sulu, the Batanes, and the Cagayan Valley are good examples.

Animal diseases in this Archipelago have played an important part in the history of the country for more than two decades. Beginning about twenty years ago and for two or three decades prior to that time the Philippine Islands had been a very prolific source of live stock, notably

cattle, carabaos, and horses. About the year 1888 rinderpest was introduced into the Islands and rapidly spread to many of the provinces, where the destruction of cattle and carabaos was very great, especially during the first two years.

Some of the older inhabitants who remember vividly the incidents of those times, say that in the early nineties rinderpest was ravaging some of the islands at a fearful rate, and an American who was visiting here in 1892 says that at that time the cattle in Masbate were dying in large numbers on the ranges. It appears, however, that by the year 1894 the disease had largely spent itself, leaving only a fraction of many of the herds it attacked. But the remaining animals were immune to the disease and bred rapidly, so that during the last year or two preceding the insurrection of 1896 there was quite an abundant supply of work animals available in most parts of the Islands. One significant fact is that few cattle were imported in those days.

Then came the insurrection, the abandonment of farms, the destruction of live stock, the prevalence of disease. In the early military days some eight or nine years ago shipments of cattle arriving from places across on the China coast were infected with some form of disease which was very destructive, as ships frequently carried large numbers of sick and dead cattle on board. On one occasion a large shipment was so badly diseased that the military officer in charge of shipping ordered the cattle discharged, put in the hands of a veterinarian, sent out to what is known as the Jones subdivision of Manila, and there held in quarantine until they were all slaughtered or had contracted the disease and died or recovered. Some veterinarians still in the Government service remember that this is only an example of what followed in subsequent shipments from China and Indo-China.

The Government imported large numbers of cattle and carabaos under contract and many of these suffered from diseases, of which rinderpest was the most destructive. One of the orders issued by the provost-marshal-general in connection with the military government of the city of Manila was the placing of a veterinarian in charge of the slaughter-house, with instructions to prohibit the killing of diseased animals for purposes of human food, to inspect all animals arriving in the port to ascertain if they were suffering from diseases, to inspect all animals shipped out of the port, and to issue a certificate showing their condition on departure. It provided no particular system of quarantine.

This was the forerunner of the veterinary section of the present city Ordinance No. 86, which is being revised at this writing. The attention of the Civil Government, like that of the Military Government which preceded, has, from the earliest days, been directed to the necessity of protecting and conserving the work animals of the Philippines.

The Bureau of Government Laboratories (now the Bureau of Science)

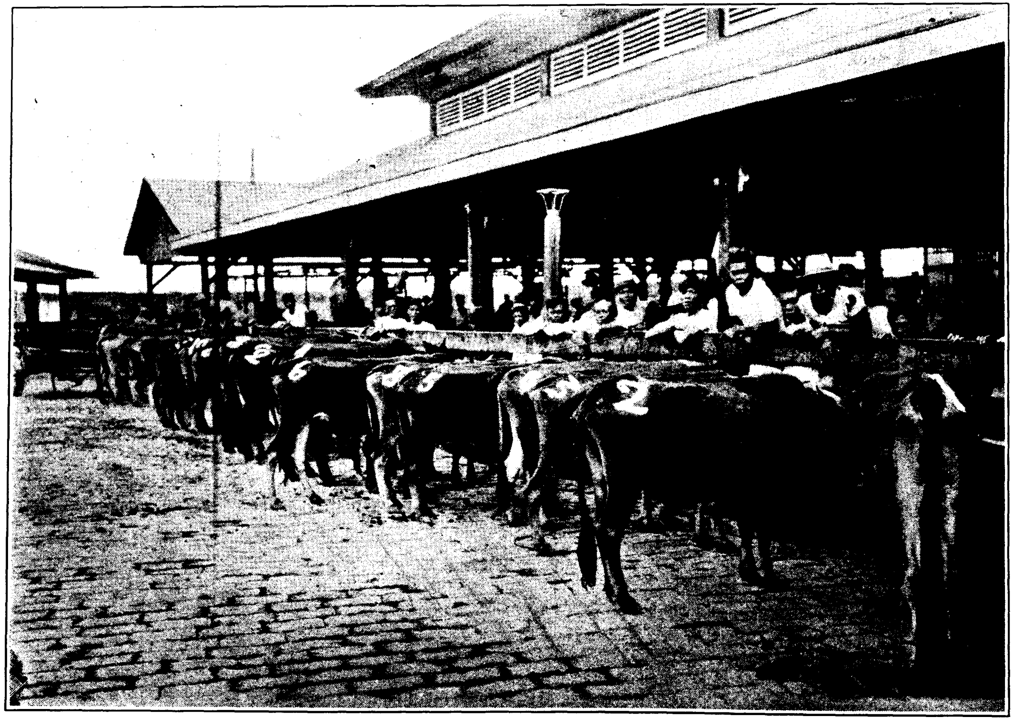

PLATE II.

undertook the manufacture of an anti-rinderpest serum, made extensive experiments in surra, and did smaller amounts of work on Texas fever, foot-and-mouth disease, and hog cholera. A veterinary corps was organized in that Bureau for the purpose of combating these diseases in the provinces. The corps was afterward transferred to the Bureau of Health and remained there until November 1, 1905, at which time it was transferred to the Bureau of Agriculture in accordance with the Reorganization Act. The Bureau of Science continued the manufacture of anti-rinderpest serum until January 1, 1907, when all the work except filtering, testing, and bottling was transferred to the Bureau of Agriculture. At the time of this transfer a radical change was made in the character of the serum by passing it through Pasteur filters and so manipulating it as to insure its being absolutely sterile after bottling.

Arrangements are now almost completed which will further improve the system of manufacturing serum, by keeping the herd outside the city of Manila, removing them from constant danger of infection from foreign shipments, placing them on a farm where the expense of maintenance will be greatly reduced, and placing the laboratory away from crowded streets where dust and other agencies militating against the successful handling of the serum will be avoided.

By consulting page 66 of the REVIEW a brief sketch of the legislation now in force regarding the control of animal diseases will be found. One feature which has not heretofore been touched on and which is of vital importance in placing any kind of disease under control, is the confidence of the people most concerned. There has been almost constant opposition to many phases of the Government work of placing animal diseases under control in these Islands, from the earliest days of American occupation, and not always entirely without reason.

This opposition has been gradually overcome within the past few years and it is not unreasonable to suppose that in due course of time the people of this Archipelago will realize the necessity for sanitary measures, preventive inoculation, general sanitation, and the placing of the general good of the whole people above the interests of merchants who are engaged in the business of selling live stock.

The cattle trade carried on by China, Indo-China, and Australia with the Philippines has gone on practically unhampered and unrestricted, regardless of conditions of disease among the animals, since the early military days to the present time. The trade is one of considerable proportions now, as shown by the importations into the Islands for the years 1901 to 1907, above quoted.

To allow the continuance of former conditions, by which all cattle arriving in the Philippines have been granted landing permits, means that the ports, corrals, and transportation lines will remain constantly infected with the very diseases against which we are fighting. Under

other than a popular prejudice against meats which have been in cold storage.

Enough native cattle can be had to supply the provincial trade and no real hardship would follow the total exclusion of foreign cattle. Should this course become necessary it will probably not remain permanent, as the authorities at the different ports on the Asiatic coast no doubt greatly desire to continue the live-cattle trade with the Philippine Islands and will take every reasonable step to see that animals leaving such ports for these Islands are free from infective diseases.

Finally, everyone who is interested in the eradication of animal diseases in the Philippines should bear in mind that the desired end can be attained only by—

1. Preventing the further importation of such diseases.
2. Providing live-stock depots at each of the open ports and so regulating these depots that imported diseases can not reach the provinces through them.
3. Employing a large and competent veterinary force.
4. Establishing a system of quarantine throughout the provinces whereby the movements of animals can be effectually controlled in times of disease. There is no need of hampering trade with useless quarantines at other times.
5. The manufacture of an abundant supply of serum, which is a most necessary agent in stamping out rinderpest.

Vigorous measures have been adopted with the definite object in view of completely eradicating animal diseases from the Philippine Islands. The object is attainable and the expenditure justifiable if within the means available.

BUREAU OF AGRICULTURE GENERAL ORDER No. 10.

RULES AND REGULATIONS FOR THE INSPECTION AND SHIPMENT OF LIVE STOCK.

[NOTICE.—These rules and regulations are based on Act No. 1760 of the Philippine Commission. Copies of this act in English or Spanish will be furnished by the Director of Agriculture to anyone making application for the same, either by letter or in person, at the office of the Bureau of Agriculture, Oriente Building, Manila.]

BUREAU OF AGRICULTURE,
Manila, June 5, 1908.

RULE I. *Importation and quarantine.*—1. Except as hereinafter provided, all cattle and carabaos imported into the Philippine Islands from other countries where dangerous communicable animal diseases are known to exist, and en route to these Islands for a period of less than ten days, shall be subject to a total quarantine of not less than ten days from the date of embarkation at the port of origin.

2. Until such time as the Bureau of Agriculture may be able to provide quarantine corrals and sheds in which to keep such animals during the period of quarantine, the present arrangement will be continued and they will be quarantined in suitable corrals or sheds provided by their owners.

3. Nothing in this, or any other of the rules herewith promulgated, shall be construed as prohibiting the slaughter of cattle for meat when they are in good health, or as requiring the Director of Agriculture to liberate any animals at the expiration of the ten days' quarantine, if, in his judgment, dangerous communicable animal diseases are liable to be spread to other points in the Philippine Islands, by permitting the shipment of such cattle or carabaos beyond the port of entry at the expiration of the quarantine period.

RULE II. *Importation of diseased cattle prohibited.*—In view of the fact that during the past year nearly all shipments of cattle to the Philippine Islands from Chinese territory, and especially from the port of Hongkong, have been infected with dangerous communicable diseases, as defined in section 2 of Act No. 1760, notice is hereby given that on and after June 20, 1908, the Director of Agriculture will no longer use the discretion given him by section 3 of said act to allow the further importation of cattle suffering from such diseases, except as hereinafter provided.

2. Whenever a shipment of cattle arriving in a port of the Philippine Islands from any foreign port proves to be infected with any dangerous communicable animal disease, notice will be given immediately in writing to the local consignee and by cable, if practicable, and when not practicable, in writing to the authorities of such foreign port.

3. Whenever three successive shipments arriving in the Philippine Islands from any foreign port prove to be infected with any dangerous communicable animal disease other than anthrax, notice will be given immediately in writing to the local consignee and by cable, if practicable, and when not practicable, in writing to the authorities of such port, that landing permits will not be granted for further shipments from such port containing animals suffering from such disease, save only for shipments which may have actually left such port prior to the receipt of said notice.

4. Whenever any shipment arriving from any place proves to be infected with anthrax, landing permit will be refused for that entire shipment, and for all perishable articles, such as litter, bedding, and other materials which may have become infected and serve as a means of bringing the infection of this disease ashore if permitted to be landed.

RULE III. *Shipping permits required from points declared infected.*—1. In accordance with the provisions of section 5 of Act No. 1760, the Secretary of the Interior has declared the ports of Manila, Iloilo, and Cebu infected with dangerous communicable diseases of animals.

2. Hereafter, during the continuance of such infection, no animals will be permitted to be shipped, driven, or otherwise taken beyond the city or municipal limits of these ports except when accompanied by certificates issued in accordance with said section, as hereinafter provided.

3. The public is warned that section 4 of Act No. 1760 is in full force at all times. Persons violating its provisions do so at their peril.

RULE IV. *Shipments from infected points limited.*—1. Hereafter, so long as any dangerous communicable animal disease continues to exist in any place which has been declared by the Secretary of the Interior to be infected with such disease, permits for the shipment of cattle from such place to other ports or places in the Philippine Islands will not be issued except when such cattle are destined to a port or place within the Philippine Islands where the Bureau of Agriculture maintains a system of veterinary inspection, or is prepared to establish such a system, or where a general outbreak of such disease is known to exist.

2. The Director of Agriculture will establish and maintain systems of veterinary inspection, so far as the force of employees at his command will permit, at any place in the Philippine Islands upon presentation of satisfactory evidence that the number of animals to be shipped to such

place from ports or places declared to be infected with dangerous communicable animal disease is sufficient to justify him in so doing.

RULE V. *Certain classes of animals exempt.*—The following classes of animals are exempt from the provisions of these rules and regulations, in accordance with the limitation stated for each class:

1. Cattle which have been permanently immunized against rinderpest or which have had rinderpest and recovered from it, when accompanied by a certificate issued by authority of the Director of Agriculture to this effect, and in which the marks and brands are so given as to enable anyone positively to identify each individual animal, shall not be subject to quarantine on account of rinderpest.

2. Animals imported from countries where dangerous communicable animal diseases were not prevalent at the time of embarkation, and which have been on shipboard more than ten days, and found to be free from such diseases, may be transhipped without landing and transported to any part of the Philippine Islands.

3. Animals imported from countries where dangerous communicable animal diseases were not prevalent at the time of embarkation, arriving at a port declared by the Secretary of the Interior to be infected with dangerous communicable diseases of animals may, if found to be free from such diseases on arrival, be transhipped without landing and transported to any part of the Philipine Islands, the provisions of Rule I to the contrary notwithstanding.

4. Animals actually employed in road or field work may be allowed to leave and enter any city, municipality, province, township, or settlement where dangerous communicable animal diseases have been declared by the Secretary of the Interior to exist, whenever in the opinion of the Director of Agriculture they can be permitted to do so without danger of contracting and spreading such diseases, and under such rules as he may prescribe.

5. Native cattle shipped from one port or place to another within the Philippine Islands, when free from dangerous communicable animal diseases, and so handled as, in the opinion of the Director of Agriculture, to prevent them from contracting and spreading such diseases, shall not be required to be certified by the Director of Agriculture.

REPEAL OF ORDERS IN CONFLICT.

The live-stock quarantine order issued by the Secretary of the Interior on November 27, 1907, General Order No. 9 issued by the Director of Agriculture on April 30, 1908, and all other orders or parts thereof which are in conflict with these rules and regulations, are hereby repealed.

G. E. NESOM,
Director of Agriculture.

Approved:
DEAN C. WORCESTER, *Secretary of the Interior.*

REPORT ON THE ANIMAL INDUSTRY OF INDO-CHINA.

By CHARLES G. THOMSON, D. V. M.

In accordance with your instructions of January 8, 1908, I proceeded via Hongkong to Saigon, Indo-China, arriving there January 22. I presented my letters from His Excellency the Governor-General of the Philippine Islands to the Governor-General of Indo-China. His Excellency expressed the cordial attitude of the government of Indo-China toward the Government of the Philippine Islands and his desire to coöperate in the furtherance of commercial relations between the two countries. He was deeply interested in the subject in hand and said that any suggestions this Government might offer as to quarantine and veterinary inspection of animals destined for Manila would be executed if practicable.

EXPORTATION OF CATTLE AND CARABAOS.

Cattle and carabaos abound in such numbers in Indo-China as to render their market price far below their value in the Philippine Islands and other near-by countries. Exportation to the Philippine Islands is therefore quite profitable, but the shipment here of thousands of cattle during the past year has aroused the authorities and the European population to the necessity of retaining the greater part of their best animals. This sentiment is easily understood when one considers the immense agricultural development of the country and the consequent demand for cattle and carabaos; the increase in the market price of these animals both for labor and food purposes; and the fact that the French are not realizing any profit from the industry.

Only foreigners have so far engaged in the business of exporting live stock from Indo-China. The people engaged in this business must surmount many difficulties. The cattle centers are some distance from the ports, so the buyers must proceed inland buying up cattle in small bunches, two here and three there, until a herd has been gathered of sufficient size to warrant the chartering of a steamer. The natives will not accept bank notes, so silver coin must be carried inland by pack horses. There are no facilities for transportation in those mountainous districts from which cattle are obtained for export. The animals must

be driven overland to the ports and fires have to be built at night to protect them from tigers and leopards, which abound in Indo-China. And then, too, the suspicious attitude of the natives toward foreigners and their slow methods of transacting business are factors of considerable annoyance.

The men engaged in the business of exporting cattle from Indo-China all desire the maintenance of a quarantine in that country, if only for their own protection. Most of the animals destined for Manila are kept in corrals for some few days before shipment, awaiting the arrival of other animals from more remote districts and the coming of the steamer on which they are to be shipped, but are not subject to veterinary inspection at the present time.

CLASSES OF LIVE STOCK IN INDO-CHINA.

Horses.—The native horse of this country is a pony resembling in some respects the Filipino pony. Some of them are larger, but of a coarse type, showing their relation to the Chinese horse. They are comparatively few in numbers, and are supplanted by the jinrikisha coolies as a means of transportation.

Cattle.—Most of the cattle in Indo-China are of the kind known in Manila as "Saigon" cattle. They are of good beef type, but small. In their natural environment they present a far better appearance than that observed in Manila, carrying much more flesh. They are possessed of wonderful grazing ability and use their pasturage of sparse grass, young bamboo, and wild green stuffs to splendid advantage. The natural grasses of Indo-China are not superior to, nor more abundant than those in the Philippine Islands.

Cattle raising up to this time has received but little attention from the European inhabitants of Indo-China, but many inquiries on the subject have stimulated interest and a number of Frenchmen have intimated their intention of soon engaging in the cattle business.

The centers of greatest cattle breeding are in the hills of southern Annam and in Cambodia, where the animals run at large, unattended. The number of cattle in Cambodia is estimated at 350,000, in Annam over 1,250,000, and in Tonkin about 1,000,000.

The market value of cattle varies somewhat in different provinces and sections, the average being from ₱12 to ₱20 (piastres). In some sections cattle are so numerous that in the absence of a ready market they are practically without value. The governor of Faifo stated that the natives in that section often kill cattle for their hides alone.

Carabaos.—In size and conformation the carabaos of Indo-China are about identical with those of the Philippine Islands. The carabaos, being stronger, are of more value than cattle in rice cultivation. The natives take more pride in them and place more value on them than on any other domestic animal. This preference of the natives, and the fact that

carabaos are less hardy and more difficult to breed, tend constantly to raise the market value. At the present time prices range from ₱20 to ₱45.

Hogs.—The hogs of Indo-China are of a far better kind than those native to the Philippine Islands. As a flesh type they are splendid, being of compact conformation, straight-backed, heavy-loined, and with big hams. The hollow-backed, sway-bellied type so common in the Philippine Islands is not numerous in Indo-China.

The hog industry is considerably developed, as swine of any size and in good condition find a ready market at home or in Hongkong. The average price of hogs as quoted to me is ₱10 to ₱18. The natives appreciate the response of the hog to generous feeding and before marketing feed them with rice and other available food stuffs.

Sheep and goats.—There are some few sheep in Annam, but I had no opportunity of observing them.

There are very few goats in Indo-China, the types there being about the same as those in the Philippine Islands.

LAWS RELATIVE TO LIVE STOCK.

The provinces of Cambodia, Annam, and Tonkin have no registration of cattle and no taxation. Cochin-China has a system of registration. Some changes in the laws relating to the exportation of live stock, especially of carabaos and cattle, have been under consideration the past year, during which time considerable inroads have been made on the number of cattle in Indo-China by exportation to the Philippine Islands and Hongkong. The laws, as they stand now, prohibit only the exportation of female animals, but a measure recently passed and sent to France for confirmation will prohibit the exportation of all animals under 5 years of age.

However, the lack of registration in those provinces from which cattle are shipped to the Philippine Islands will render the enforcement of this law nearly impossible. A statute limiting the number of cattle to be exported to 10,000 annually is now under consideration. The province of Cochin-China has prohibited the exportation of any cattle or carabaos, as the retention of all these animals is deemed necessary in that province because of the immense agricultural development and the large demand for cattle for local consumption.

VETERINARY SANITARY LAWS.

The French law of 1881 applies to Indo-China, being amended to include certain tropical diseases existing in that country but not in France. These laws provide for a rigid quarantine around districts known to have been affected, the quarantine to be maintained until the veterinarian in charge releases the animals, or until one month elapses from the date of last evidence of infection.

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Animals suffering from, or having been exposed to, rinderpest or certain of the other dangerous diseases, are slaughtered, the owners being allowed an indemnity of three-fourths the value of the animals killed.

The veterinarian suggests to the provincial authorities any additional quarantine provisions deemed necessary. The suggestions are made ordinances and rigidly enforced.

VETERINARY SERVICE.

The veterinary service is well organized and distributed, consisting of twenty-four men who are stationed in the so-called sanitary districts, as follows:

Cambodia.—Pnom Penh (2), Prey Kompong (Cochin-China), Saigon (2), three auxiliaries.

Annam.—Than Hoi, Hue, Nha Trang, Qui Nhon, An Khe.

Tonkin.—Hanoi (4), Haipong, Phu-lang Thuang, Nuoc Hai, Thai-Nguyen, Thuyen-Quang, Yen Bag, Nin Binh.

M. Lepinte, is the chief.

The veterinarians are responsible for the sanitary condition of their respective provinces and must control any outbreaks of infectious disease that may develop. They superintend the zoötechnic institution of their province and inspect at the abattoir daily. Each has a corps of competent assistants and is provided with a laboratory containing the necessary bacteriological apparatus. They are well paid, receiving an average of about $1,800 (United States currency) per annum. In addition each is provided with a house at his permanent station and with horses or coolies for local transportation.

Upon retirement from the service they receive a pension from the government, the amount being proportionate to the length of time in the service. When called from a permanent station to more remote districts in the provinces they are given every available facility for transportation.

VETERINARY COLLEGE FOR NATIVES.

In 1904 the construction of the buildings was begun, being completed in all essential details in 1905. The college is located in the city of Hanoi, the capital and most important of the cities of Tonkin. Its location in Hanoi commands a ready supply of all the domestic animals for clinical and experimental observation.

This college is for the natives (Annamites) only. At present there are some thirty students at the college, these men having been selected from the native high-schools for their adeptness in studies and especially for their proficiency in the French language. The government pays the students about ₱15 a month while at college, this sum being sufficient to

support them. The payment of this monthly salary renders it possible for even the poorest boy to study there, if he maintains a sufficiently high average while in the high school to warrant his appointment. This necessarily stimulates scholarship in the lower schools and secures ambitious young men for the college.

On graduation the Annamites are stationed in the provinces where each must, first, keep closely in touch with the sanitary conditions in his district; second, must deal promptly by quarantine measures and use of serums with any diseases of infectious nature that may develop; third, must respond to calls upon his services made by the inhabitants who possess sick or injured animals. They are not entitled to fees from the natives for these services, but are paid 700 pesos (piastres) annually by the Government of the Province of Tonkin. They are furnished by the government with serums, medicines, and necessary instruments. The first graduating class leaves college this year. The authorities anticipate highly efficient services from them, because, being natives, they can easily gain the confidence of the people in those measures and inoculations deemed necessary against infectious disease, and by mingling with the natives can quickly discover any outbreaks of disease that may occur. (It is interesting to note that the French authorities and veterinary corps have experienced the same difficulties which have been met in the Philippine Islands, in obtaining information of outbreaks of disease before the infection has become widespread.) The reduction in salary average of the veterinary corps will be considerable.

The main building is the study hall, in dimensions about 30 by 100 feet. It is divided into three halls, one for each of the three classes, each hall containing a library, and the other things necessary at its particular period of study. Adjoining this building on the left is the hospital for horses, mules, cattle, and other large animals which may be entered at the clinic. This building contains about ten large, well-ventilated stables with slightly inclined asphalt floor permitting of good drainage, and measures about 18 by 60 feet. Adjoining this is the clinic, containing the operating room, which is not complete in detail as yet, and the dispensary, in which the students themselves compound all prescriptions. In this building there are, also, the pens for dogs, cats, and other small animals which may be entered for observation. These pens are uniform iron-barred cages, measuring about 5 feet square and high. There is near by a small shed wherein the small experimental animals (guinea pigs, rabbits, and rats) are bred and kept. Each department is supplied with instruments, apparatus, and specimens necessary for its particular branch of study and work.

All of these buildings are constructed of brick and faced with concrete, presenting an appearance of solid granite. They are arranged in the form of a capital "E" inclosing an open court, sodded with grass,

where convalescents are allowed to graze. The entire grounds and buildings are surrounded by a high concrete fence, and as a whole present a most cleanly and fresh appearance.

The staff of instructors comprises three veterinarians and two physicians. They are all government men and are specialists in the subjects which they teach. The actual clinical work is in charge of the military veterinarian who is stationed at Hanoi. He is an exceedingly practical veterinarian because of the nature of his duties.

The students must devote three years to college work. The first year study embraces anatomy, physiology, and the other basic subjects. Much time is spent in actual dissections of the horse and other domestic animals. The second-year work includes materia medica, therapeutics, surgery, pathology, bacteriology, and the methods of handling the specific infectious diseases. The work in the third year is devoted to much practical work, in the clinic as well as to a deeper study of all the veterinary subjects. The various courses are demonstrated by means of text-books, lectures, papier-maché models, and charts, up-to-date apparatuses being supplied for the pursuit of the advanced studies. Throughout the course special stress is laid upon the subject of infectious diseases and the methods of handling outbreaks, and considerable attention is devoted to parasitism. The third-year men have all obtained a splendid grasp of veterinary science and, in clinic, manifest a pronounced enthusiasm in their work.

When I visited the college (February 15 and 16) the hospital was filled with patients suffering from the various diseases common to domestic animals. These animals had all been submitted for treatment by their owners in Hanoi. A nominal charge is made by the college authorities for the subsistence of animals, the medicine and attendance being free.

It is impossible, at the present time, to furnish an estimate of the cost of construction and maintenance of the college, but these figures will soon be at hand, as Monsieur Brenier, subdirector of agriculture and commerce, is sending the annual budget of the province of Tonkin, which should arrive about the 25th instant. However, this estimate will be misleading, as labor and materials of construction are considerably cheaper in Indo-China than in the Philippine Islands.

DISEASES PREVALENT.

Rinderpest.—Rinderpest has existed in Indo-China since 1896. In 1899 very severe losses were caused by a widespread outbreak. In recent years the disease has never been so widespread nor so virulent as to cause any considerable anxiety, it being confined almost entirely to Tonkin and existing there only in isolated outbreaks.

The virulence of rinderpest as observed in Indo-China varies in the different sections, but nowhere is it as high as in the Philippine Islands. The outbreaks in the northern part of Tonkin have been the most virulent, the mortality being about 50 to 65 per cent in cattle and 80 to 90 per cent in carabaos. In southern Annam the mortality ranges from 15 to 25 per cent in cattle and 40 per cent in carabaos. In Cambodia and Cochin-China it is seldom identified. Phuyen, from which large numbers of cattle have been shipped to Manila, has never been subjected to rinderpest, as it is inclosed by a chain of high mountains effectually shutting off all intercourse with the surrounding districts which have from time to time been infected.

In combination with other diseases rinderpest presents a much more formidable mortality. It is occasionally observed with surra and septicæmia hæmorrhagica.

Surra.—Surra has been observed in Indo-China for some years and in all respects is similar to that encountered in the Philippine Islands. The disease is most prevalent in Cambodia.

Anthrax.—Anthrax is almost unknown in Indo-China, no serious outbreaks having been observed there during the occupation of the French. A few isolated cases have been identified from time to time by Dr. Yersin, of the Pasteur Institute.

Symptomatic anthrax (blackleg).—This disease has been identified by Drs. Yersin and Vassal, the latter having observed about fifty cases in some five years.

Foot-and-mouth disease.—This was identified in 1899, but in later years has not been observed.

Texas fever.—Nearly all of the cattle of Indo-China carry the cattle tick and, like the cattle of the Philippine Islands, are immune to Texas fever.

Glanders.—This disease exists in Indo-China, but has never constituted a serious menace to the colony. The positive diagnosis of glanders is followed by the immediate slaughter of the infected animal.

Dourine.—Dourine exists in Indo-China, being especially common in Cambodia. There is an outbreak there at the present time, so any horses coming from that district should be carefully examined, if admitted into the Philippine Islands.

Tuberculosis.—Abattoir records show that tuberculosis exists among the cattle of Indo-China, about two-tenths of one per cent showing lesions on post-mortem.

Rabies.—This disease is very common among dogs in Indo-China.

SERUMS USED.

Anti-rinderpest.—Anti-rinderpest serum is manufactured at Nha Trang by the Pasteur Institute, a branch of the Paris establishment. It is a private institution, the output of the serum laboratory being contracted for by the government. The peritoneal-wash method of Adilby, of Constantinople, is used in the preparation of anti-rinderpest serum. It is impossible to pass upon the efficiency of this serum in comparison with that manufactured in Manila, as I had no opportunity to compare equal inoculations of the two.

The dose of their serum is 20 cubic centimeters and the immunity given is for but three weeks. The cost of the serum to the government as quoted to me is about ₱1 per dose of 20 cubic centimeters, which is about double the cost of that prepared in Manila. This in spite of the fact that animals for serum purposes can be purchased fully 100 per cent cheaper in Indo-China than in the Philippine Islands. There are 700 serum animals at Nha Trang, from which 200 liters of serum are prepared per month.

Anti-septicæmia hæmorrhagica.—This serum is also prepared at Nha Trang. The process is long drawn out and the serum when prepared is not very efficient in giving even a short immunity against the disease. In preparation, the serum animals are inoculated with 1 cubic centimeter of virus simultaneously with 20 cubic centimeters of serum, this inoculation being preceded two days by an inoculation of 20 cubic centimeters of serum.

The virus is a culture from agar slant diluted ten times with sterile water and is very strong. If given alone it would cause the death of the animal in from twenty to thirty-six hours. The day following the inoculation the temperature of the animal usually rises to 40+° C. but recedes to normal the next day thereafter. After two weeks the same inoculation of virus is repeated and is usually followed by a light reaction. Following this at intervals of two weeks injections of 5, 10, 15, 50, 100, and 200 cubic centimeters of virus are given. The animals are then bled when their condition warrants. This extended process of immunization is necessary in the preparation of this serum as the virus is strong, resistance weak, and hastening the process results in decided emaciation of the animals.

Phlebotomy is resorted to in drawing blood from anti-septicæmia hæmorrhagica serum animals. Two liters only are taken at one bleeding. The blood is allowed to coagulate in a cool place and the serum is not sterlized, but bottled when poured off. Cylindrical earthen jars of 2 liters capacity are used to contain the blood. A perforated metal plate is adjusted at the top of each jar and is allowed to sink when the clot is forming, so as to press out all of the fluid possible.

DANGER OF IMPORTING DISEASE FROM INDO-CHINA INTO THE PHILIPPINES.

Importations from Indo-China to date have been, with two or three exceptions, singulary free from rinderpest and other infectious diseases, and conditions in that country are such as to warrant the prediction that future importations will carry as little, if not less, disease.

It has already been mentioned that but little rinderpest exists in Indo-China at the present time, and that those outbreaks occurring are of low virulence and so isolated as to be very easily placed under control. It has also been pointed out that those districts from which the most of our cattle are obtained (and from which they must always come) are especially free from the infectious diseases.

These conditions, together with the protection afforded by the well organized and equipped veterinary service and the laws prohibiting exportation from districts known to have been recently infected with rinderpest or other diseases of infectious nature, are of deep significance in the question of obtaining healthy animals from foreign countries for the Philippine Islands.

If advantage is taken of the proposition of the governor-general of Indo-China to provide ample quarantine facilities and veterinary inspection before embarkation of animals destined for the Philippine Islands, importations from that country should be almost, if not entirely, free from infectious diseases.

ZOÖTECHNIC WORK AND RESULTS.

The Zoötechnic Institution was established about twenty years ago but only during the last ten years have any determined efforts been made in this work.

The institution is under the direction of the bureau of agriculture, through its chief veterinarian. The main station is at Hanoi. This establishment is the most complete institution of its kind that I have ever seen. It is composed of twelve buildings constructed of brick and faced with concrete, distributed over the 40 hectares of land belonging to that station.

Beside the principal station at Hanoi there are numerous other stations at various important cities of Indo-China, but these are not so large or so well improved. An annual appropriation of about ₱200,000 is provided by the general budget for carrying on the zoötechnic work and special appropriations are made for importations.

Horses.—The main object of the institution is the improvement and increase of the Indo-China horse, and with this purpose in view over 700 sires and dams have been imported from Russia, Australia, France, Germany, Spain, and England. At the present time there are about 200 of these imported animals at Hanoi.

The French authorities in their efforts to produce better horses by crossing with the native stock have proceeded along different lines from those followed in the Philippine Islands. In addition to importing sires and breeding to the native mare they have also imported mares and used the native sire. The results have been good, as the foals from the large mares have been uniformly large and sturdy. However, it is problematical if this course is wise. The imported mares can produce but one foal a year each, while on the other hand the same amount of money expended in importing sires would have resulted in probably fifteen times the number of offspring.

The government of Indo-China offers every inducement to the inhabitants for the use of selected sires deemed best. There are some sixty sires distributed throughout the country and maintained solely for service of animals belonging to the natives. The government pays ₱4 to the owner of every native dam that drops a foal by a government sire; this as an inducement for the use of the sire. Or the government will import mares and sell to any responsible person for 60 per cent of their cost, landed. For the first foal dropped the government pays 30 per cent of the original cost of the dam, and for the second, third, and fourth 20 per cent each, the owner of the dam retaining the foals.

In three years, if three foals have been dropped, the possessor of the mare has been paid by the government almost the original cost to him and yet has the four animals.

The government reserves the right to purchase any winners at the race tracks desired for the stud, and fixes a maximum value of ₱500 for this purpose. I mention this to show that the government of Indo-China is sparing no expense in their efforts to improve the native stock of the colony.

Cattle.—The government appreciates the significance of the cattle industry in the commercial economy of Indo-China and has endeavored to give it impetus at different times and to emphasize the advantage of improved methods of handling and breeding. There is ordinarily no systematic breeding or selection of sires and dams, the animals being simply allowed to graze and increase by natural selection.

Expositions of live stock are held from time to time at Hanoi, Phuyen, Phnom Penh, and other places, at which the best native cattle are exhibited along with imported animals of good beef and dairy breeds.

Some efforts have been made to introduce dairy cows from France into Indo-China, but without success. The offspring obtained by crossing these dairy animals with native cattle has reverted into the beef type. Other experiments along the dairy line have not been successful. Improvements in the beef type have been attempted and have met with some success. The results obtained by the use of imported Indian sires have been the best to date.

Sheep.—Attempts to introduce imported sheep into Indo-China have meet with decided failure until within recent months, when sheep were brought from the Malay Peninsula which up to this time have been doing well and breeding rapidly.

Hogs.—Not much has been done in the improvement of hogs, the native stock being of so good a type that much improvement is not necessary and efforts therefore have been directed along other lines.

In concluding this report, I wish to express my appreciation of the courteous reception and assistance extended to me by His Excellency Governor-General Beau, Mr. Capus (director of agriculture), Mr. Brenier (subdirector of agriculture), and Mr. Lepinte (chief veterinarian), and especially I wish to mention the kindly interest and assistance afforded me by Mr. Connor, United States consul at Saigon, and Drs. Schein and Vassal, of the Pasteur Institute at Nha Trang. The efforts of these gentlemen were of invaluable help to me in the performance of this mission.

Respectfully submitted.

LOCUSTS.

By Charles S. Banks, *Bureau of Science.*

HABITS AND LIFE HISTORY.

1. The Philippine migratory locust is not limited in its journeys whether by mountains or large stretches of water. It can easily fly from any island of the group to any other.

2. Full-grown locusts usually remain in a cultivated region only long enough to lay their eggs. Many people have stated that they generally come from the direction of mountains, so it is probable they remain each year for a certain period in inaccessible mountain regions.

3. Locusts always lay their eggs in the ground. They prefer rice or cane fields, but use uncultivated ground if it is soft so that they can make holes to a depth of 4 to 6 centimeters. The eggs as they are being laid are covered with a glue which soon hardens. This makes the egg mass (containing 40 to 100 eggs) waterproof. If the ground is very wet the eggs may rot, but this is very exceptional.

4. The eggs hatch in about seven or eight days and when hatched *the black loctones are about the size of a house fly. At first they are very weak and this is the best time to exterminate them.*

5. Young locusts go only a short distance from the places where they hatch until they have wings. To grow wings takes about a month. During this time they eat many hundred times their own weight of green food.

6. *Locusts always go in companies* even when first hatched, and until they have wings they may easily be driven in any desired direction. They follow a leader.

7. *Most of the locusts die soon after the females have laid their eggs.* Those going to the mountains are probably the ones which have not yet laid eggs.

HOW TO FIGHT LOCUSTS.

1. The so-called "Locust fungus" *has not yet been found to be useful in combating the pests,* so no thought or hope should be entertained for a wholesale destruction by any such method.

2. *It is easiest to fight locusts just as they come from the egg, because they are then very weak.* Scatter dry cogon, talahib (tigbao), or other

grass over a field where the holes in the ground show that the locusts have just laid their eggs. Have the field watched and have the watcher notify the people as soon as the eggs begin to hatch. Then have the grass burned just *when the loctones are coming out from the ground. This method will destroy larger quantities of locusts than any other, because the loctones are more closely congregated than at any other time.*

FORTY TO A HUNDRED COME OUT OF EACH HOLE.

3. If the young can not be burned in this way, drive them into trenches, pits, or troughs before they have wings. In the trenches cover them with earth or crush them. Do not try to drown them, because they can easily swim over swift streams 50 to 150 meters wide.

4. Full-grown locusts are hard to fight. They may be frightened away by beating tins, firing guns, or waving large cloths or branches in a field. *At night they may be attracted to large bonfires and many thousands can be destroyed in this manner.*

5. It is absolutely necessary that *all indviduals in a locality work* together in fighting or driving locusts away. If one pueblo after the other attack them in these ways, they may be kept out of cultivated regions and remain in waste places.

6. *Any person knowing of wild regions where locusts habitually go* would greatly aid the work of studying them by sending word to the *Entomologist* of the *Bureau of Science.*

BUD ROT OF THE COCONUT.

By Edwin Bingham Copeland, *Bureau of Education.*

BUD ROT IN THE PHILIPPINES.

REPORT OF MARCH 14, 1908.

I have the honor to report that in accord with your verbal direction I left Manila March 5, to investigate the coconut disease reported from Lilio and Nagcarlan, in the Province of La Laguna. I reached Santa Cruz at 2.30 p. m., and found neither Mr. Cailles nor Mr. Lamb in town. As I had been told in Manila that the disease in question which is a bud rot, had made its appearance in Magdalena, I communicated with the president of the municipality by telephone. He knew nothing of such a disease, but one of his policemen thought he did and was sent out to locate it. I also interviewed Vicente Reyes, who is prominent for his coconut holdings in Magdalena; he was likewise ignorant of any bud rot. The vice-president of Santa Cruz, Bernardino, took me to see some coconut trees in the barrio of Pagsauitan, which he believed to have been killed by bud rot. Three had been felled; one was standing, with a few old leaves remaining. So far as can now be told, these trees were killed by bud rot, but no other trees in the neighborhood show any signs of infection.

The morning of March 6 I went to Magdalena, and found that the policeman's search for bud rot had been fruitless. I then went to Lilio, met the president, Buenaventura de Miguela, canvassed the situation with him, and made an appointment to visit his most afflicted barrios the following Monday. I then went to Nagcarlan with Mr. Griffin, and made his house my base for the next five days.

March 7, accompanied by Mr. Griffin and Dr. Robinson, the new botanist of the Bureau of Science, I visited Lazaan, the barrio of Nagcarlan in which the bud rot is most prevalent. The following day, Sunday, I went up through Sinipian and Mapapatid. In the former barrio are a few trees apparently killed by bud rot, but none were seen now ailing. In Mapapatid I saw no sign of the disease and heard of none.

March 9 Sr. de Miguela and I visited the barrios of Ylaya and Sungi. The former adjoins Lazaan, and in both the disease is very prevalent

and destructive. March 10 I undertook to revisit Lazaan with the municipal secretary of Nagcarlan, Camillo Lirio, but the rain was too heavy. The next morning I made the trip and collected diseased tissue for laboratory examination. In the afternoon I returned to Santa Cruz, and the next morning to Manila.

The bud rot is at present very prevalent in Lazaan, Sungi, and Ylaya. It is present, but does less damage, in two other of the upper barrios of Lilio. There are a few scattered cases in Balanacan and Sinipian, barrios of Nagcarlan, and probably in Pagsauitan and elsewhere. The secretary of Lilio, Sr. de la Peña, has heard that it occurs in Majayjay and Magdalena, but has no personal knowledge of it in either. Mr. Griffin inquired about it for me in Majayjay, but could learn nothing positive. Captain Grove has heard that many years ago it practically wiped out the coconut industry of Lucban. And I have been told that it was very destructive about five years ago in Sariaya. I should have visited Lucban and Sariaya, but regarded it as of primary importance to secure remedial legislative action in La Laguna, and to establish by laboratory study the nature of the disease.

In the badly infested districts there are patches where almost every tree is smitten, and larger ones where fully half of the trees are dead or dying. Although the disease has been present in Nagcarlan fully ten years, the damage now in evidence has been done, at the outside, within three years. Dead trunks of coconuts do not usually stand for two years, but I am told that trunks of trees killed by bud rot stand for rather more than this period. However, I have not found the naked trunks more numerous than those with some old leaves still at the top; and the latter can hardly have been attacked as much as one year ago. The impression made upon me is that under conditions favorable to it the disease will kill half of the trees in a single year. Under less favorable conditions it is less violently epidemic; and it is my present opinion that in most parts of the Philippines it will never prove violently destructive. The fact that a given tree escapes one year is no guaranty that it will not be killed the next. Under conditions favorable to the disease it is only a question of time, unless vigorous restrictive measures are carried out, when practically every tree will succumb.

The inhabitants of the infested district are almost unanimous in stating that a tree which once shows symptoms of bud rot is sure to die. Only two men told me otherwise, and they agreed that recovery was very rare.

The climatic condition permitting the disease to be exceedingly destructive is a very moist atmosphere. The upper belt of coconut country about Mount Banajao is one of the most humid districts in the Islands. A secretary of Nagcarlan, now dead, noticed the restricted occurrence of the disease long since, and from it deduced the mistaken theory that the

disease was caused by cold. The coconuts at the foot of Mount San Cristobal, which are comparatively unreached by the wet ocean winds, are free from bud rot. The people of Lilio and Nagcarlan maintain that the disease is gradually descending into the lower groves. Below the zone where the bud rot is most at home, there is of course a region in which infection can occur under conditions temporarily favorable, or affecting single trees or small localities. As any tree for miles around is likely to receive the germs, it is inevitable that in this lower zone some will be infected each year. As these die, the damage is cumulative, and the gaps in the lower groves increase in number or size. But I can see no good evidence that the region in grave peril is widening downward. As already stated, there are spots, probably even as low down as Pagsauitan, where single or few trees have succumbed; but even higher up than the centers of population of Nagcarlan and Lilio the climatic conditions have prevented these spots from becoming centers for the rapid spread of the disease.

Further evidence that humidity is a condition of contagion is found in the fact that young trees are more susceptible than old ones. About the crowns of old, tall trees the air moves comparatively freely, and keeps them comparatively dry. Every inhabitant of the infested district recognizes the greater susceptibility of the young trees; the general opinion is that for every old tree killed two which are just coming into fruit, or would do so within a year or so, die, although the total number of such trees is naturally much less than that of adults. On the other hand, very young trees, of two years or less, are for some reason comparatively rarely attacked.

Since humidity is the condition of easy infection, the extension of the disease occurs principally during the most humid season. At the present time there are numerous trees in advanced stages of the disease, but exceedingly few which show the first symptoms.

The first symptom always in young trees, and almost always in old trees, is the yellowing and wilting of the youngest, still folded leaf. The disease attacks the soft, undifferentiated tissue of growing points. It is likely that infection normally occurs where the germs can get direct access to these points without penetrating through mature tissue; but the germs might also be borne by insects which could carry them in through mechanical lesions in old tissue. In young trees, the youngest leaf presents the only possible path of direct unaided infection; and however infection might occur the youngest leaf is directly inserted in the tissue susceptible to rot, and must die before the rot embraces the most of the soft tissue—commonly known in English as the "cabbage." As soon as the youngest leaf is noticeably discolored, it can easily be drawn out. The next youngest leaves follow in rapid succession. Within two or four months after the disease can first be detected the most

PLATE IV.

of the leaves will have fallen. A few of the oldest leaves grow from tissue so hard that the rot makes little or no progress in it; these leaves, four to a dozen in number, persist for months after the younger leaves are gone. It is in this stage, with a thin whorl of old leaves crowning the stem, that the most of the diseased trees are found, at least at this season. These leaves very likely fall only when their natural time comes, uninfluenced by the rot.

In the case of old trees, the young flowering branches, like the youngest leaves, spring from near the soft heart. Infection might occur along these branches, and they might give the first external signs of disease. In some countries the withering or fall of these branches is said to be the first symptom of bud rot, and some of my informants state that this is sometimes the case here. No such case came under my notice; but, as already said, there are now very few trees showing any early symptoms. Branches whose nuts are more than half grown are grounded in mature enough tissue so that the disease does not usually prevent the nuts from maturing. But no new nuts are set after the appearance of the rot, and the youngest nuts almost always, or quite always, fall without becoming ripe.

As has been found always true of coconut bud rot elsewhere, the decaying tissue has a powerful and vile odor. The stench is very characteristic, but not easily described; one of its components is the smell of tan. An attempt is now being made in the Government Laboratory to separate the organisms present, and this will be followed by inoculation experiments. I have already ascertained that no fungus mycelium is present in the advancing border of the diseased tissue.

The inhabitants of Ylaya have found that if the first leaves affected are pulled out, and the rotten mass removed as completely as possible, new leaves will sometimes appear afterward, and that in some of these cases the tree recovers. One man states that 25 per cent of cures can be effected in this way; I do not believe that this is possible, and other men that I asked agreed that if any ultimately recovered they were exceedingly few.

For practical purposes, the tree, once it shows any symptoms of the disease, is valueless, and is fortunately so regarded by the people. The thing to be done is to prevent the spread of the disease from it to other trees.

While the people understand the end to be gained, the use by them of any disinfecting chemicals can not be expected to be effective, because of the difficulty of making the disinfectant reach every part of the diseased tissue.

The only agent which can be relied upon to destroy the organisms is fire. Every tree which shows symptoms of the disease should have its heart and the structures immediately around it—the apex of the trunk

and the bases of the leaves, at least the sheaths—completely burned. During the drier season this is not a very difficult matter, and every diseased tree in the whole infested district should be so destroyed during this dry season. Even if this is done it is to be anticipated that during the first few succeeding rainy months numerous cases will appear. These must also be burned, and this will be practicable only by the use of petroleum. In my opinion, a vigorous campaign of six months, beginning at this time, will so restrict the disease that it will cease to be a serious menace to the coconut industry.

The president of Lilio states that he will see an ordinance passed at the next meeting of the town council requiring such treatment of every diseased tree in his town, and that the ordinance will be enforced. With some effort I got the same promise from the president and secretary of Nagcarlan. To make such an act really effective it is necessary to have a competent and active inspector, who would best be locally acquainted, but must be without political friends and enemies. The people of the towns affected would like to have Mr. Griffin act in this capacity, and if it can be done it is very desirable that he be so detailed.

I was unable to see either Mr. Lamb or Governor Cailles the night I was in Santa Cruz, but left a memorandum with the secretary recommending action backing up the towns of Lilio and Nagcarlan and extending the regulation to any other towns in which the disease may appear. As soon as La Laguna shall act in the matter, the reported occurrence of the disease in Tayabas should be investigated and similar action be secured there.

RESOLUTION OF THE PROVINCIAL BOARD OF LA LAGUNA.

[Extraordinary session of March 13, 1908.]

Whereas it has been represented to the provincial board by duly qualified inspectors of the Bureau of Education and by the owners of coconut plantations and the municipal officials of various municipalities that in certain districts of this province, especially in the jurisdiction of Lilio, Nagcarlan, and Magdalena municipalities, the agricultural pest known as bud rot has killed many coconut trees, is becoming widespread and is a serious menace to the coconut groves throughout the province: Therefore, be it hereby

Resolved, That by authority in the law the provincial board hereby approves for the entire Province of La Laguna the following resolution:

Any owner or lessee or person or persons having the management of coconut plantations, coconut groves, or coconut trees shall, upon the appearance of the pest or disease known as bud rot, immediately report same to the president of the municipality in which such trees are located.

Further, Such owners, lessees, managers, person, or persons who receive information, either by observation or otherwise, that the coconut trees are dying because of the pest or disease known as bud rot, or from any cause known or unknown, shall immediately report the matter to the municipal president of the municipality in which such trees are located.

Each municipal president is hereby designated as an inspector ex officio of

the provincial board, for the purposes of this resolution and shall, upon receipt of information that the disease known as but rot exists or has appeared, immediately inspect such trees and require the owner, manager, or "encargado" of such coconut trees to cut down such trees and destroy completely, by burning, the crown or top of every tree so cut down and having the disease known as bud rot.

Further, Any municipal president, as inspector, who fails to take the action required by this resolution, and especially the foregoing paragraph, shall be punished by a fine not exceeding ₱200 or thirty days' imprisonment, as may be decreed by the court having jurisdiction.

Further, That when any owner, manager, or "encargado" of coconut trees refuses to cut down and destroy completely the top or crown, by burning, all trees having the disease known as bud rot, the destruction of which is authorized or directed by the municipal president as inspector, shall be subject to a penalty consisting of a fine not exceeding ₱200 or thirty days' imprisonment, as may be decreed by the court.

For the purposes of this resolution, all inspectors duly appointed by the secretary of education have the same authority as conferred by this resolution on the municipal president as inspector ex officio. Such inspectors appointed by the secretary of education are hereby authorized to enforce the provisions of this resolution in the same manner as the municipal president, i. e., by charging any person or persons who refuses or fails to comply with the inspector's order to destroy the trees having the disease known as bud rot, before the court of proper jurisdiction.

For the purposes of this resolution, and under authority of section 13 of paragraph (*k*) of Act No. 83 as amended, the provincial board of the Province of La Laguna hereby confers jurisdiction upon all justices of the peace of the Province of La Laguna to try violators of the foregoing resolution or regulations, and there is hereby appropriated, out of any funds in the provincial treasury not otherwise appropriated, a sufficient amount for the necessary expenses in paying costs of prosecutions before justices of the peace.

Be it further resolved, That six certified copies of this resolution be furnished each municipal secretary; one copy for the municipal president as inspector, the other five copies to be posted in five conspicuous places in the municipality. A certified copy shall be furnished each justice of the peace, a certified copy to the honorable the secretary of education, and a certified copy to the honorable judge of the Court of First Instance of the Sixth Judicial District.

Votes.—Juan Caillés, yes; C. H. Lamb, yes; Marcos Paulino, yes.

Certified:

JUAN MADRIGAL,
Recorder, Provincial Board.

SANTA CRUZ, *March 13, 1908.*

DIGEST OF SUBSEQUENT REPORTS.

I left Manila on March 21 to investigate the existence of bud rot in Tayabas and to secure remedial legislation if it was found. At Santa Cruz I secured copies of the La Laguna resolution. Official copies of the resolution not having reached the hill country, I showed it to the presidents of Nagcarlan, Lilio, and Majayjay, and explained the work required. I then went to Lucban, finding infected trees at various places along the trail, both in La Laguna and in Tayabas. About Lucban

itself there were very few coconuts and I could not learn on good authority that they were ever numerous; the climate is ideal for bud rot.

On March 24 I went to Lucena, finding occasional cases of bud rot above the town of Tayabas, but none below it. After explaining my business to the treasurer, Mr. Green, I went to Sariaya. Accompanied by Mr. Westbrook I walked back through the whole of the upper coconut zone, but found no case which I would diagnose as bud rot. I then returned to Lucena for the night. Mr. Green assured me that the Tayabas board would pass a resolution along the lines of that adopted in La Laguna, and this was presently done. I then returned directly to Manila, finding no bud rot on the return trip. About Candelaria and Tiaong the ravages of beetles are very bad.

In La Laguna the resolution went into effect at once and was everywhere received with enthusiasm. I visited Lilio and Nagcarlan several times in April and May and was most agreeably struck by the zeal and thoroughness with which this work was taken up and carried on during the month following the enactment of the resolution. Many hundred diseased trees were destroyed without expense to the Government, and neither provincial nor municipal officials received any complaint whatever. When the difficulties and expense met by the Government in its warfare—against cholera and rinderpest, for example—are considered, with the fact that a coconut tree is just as real property as a house or a carabao, and property which it takes longer to produce, and the fact that in this work it was necessary to deal largely with a barrio population, the promptness and thoroughness with which this work was taken up and the absence of expense and complaint will begin to be appreciated.

Unfortunately, the provincial board was found to have exceeded its authority in the additional duties it had imposed upon the municipal presidents, and the resolution was ordered annulled. In some places the people continued to burn trees found infected, but the destruction of occasional trees, or even thorough work in single patches, is hardly more than a waste of zeal. To be worth while, the work must be done at once in the whole afflicted district, and with a thoroughness which can be obtained only by local encouragement and instruction, supported by drastic legislation, such as that already tried in La Laguna. Because of the difficulty of burning trees, the season is at present unfavorable.

We can only hope that before the beginning of another dry season legislation for the same purpose will be reënacted in La Laguna and Tayabas and that the failure to accomplish anything this year will not prevent the use of the same zeal next time. A single month's campaign against this disease can accomplish nothing, and did accomplish nothing. Six months of thorough work will bring it under control.

BUD ROT IN OTHER COUNTRIES.

The most incurable and, unless strongly handled, the most dangerous diseases of the coconut are the bud rots. These diseases attack the soft, young tissues at the apex of the stem, and sooner or later destroy the growing point itself. Since the coconut does not branch, and never renews its growing point, this immediately stops the formation of new leaves and flowering branches and very soon kills the tree. Whether or not they themselves cause the disease, gas-producing bacteria are always present in the rotting mass and produce a vile odor. From a diseased or dead tree, spores or germs can by various means be borne to other trees; they are usually carried by insects. When a tree is once infected by bud rot it is practically impossible to save it in any way, and energetic action must be taken to prevent the spread of the disease. Bud rot has been reported in the West Indies and about the Caribbean Sea, in Portuguese East Africa, in Ceylon, about the Godaveri River in India, and in Luzon. It is worth while to describe the symptoms and methods of treatment in these different regions.

A bud rot has been known to exist in Cuba for many years, but received no particular attention until an entomologist, Busck, was sent there by the United States Department of Agriculture to investigate the coconut diseases in 1901. He reported that if the bud rot continued to spread as it had in the preceding decade it would wipe out the Cuban coconut industry within ten or fifteen years. The disease is described as superficially characterized by the yellowing and fall of the outer leaves, shedding the nuts, and some months later by the death of the whole crown. As reported by Erwin Smith, the terminal bud is "involved in the vilest sort of a bacterial soft rot * * * the stench resembling that of a slaughterhouse. This rot, invisible until the numerous outer leaf-base wrappings are removed, often involves a diameter of several inches of soft tissues and a length of 3 or 4 feet, including flower buds and the whole of some of the soft, fleshy, white undeveloped leaves covering the bud and forming the so-called 'cabbage' of the palm. * * * Fly larvæ and various fungi were found in the parts most exposed to the air and longest diseased, but the advancing margin of the decay was occupied only by bacteria, of which there appeared to be several sorts * * *. All were white organisms of the soft-rot type, mostly plump short rods with rounded ends, but occasionally longer rods, all apparently gas producers. * * * The bacteria probably find their entrance through wounds of some sort, and their distribution is undoubtedly favored by carrion creatures. * * * Diseased trees should be felled, and the terminal bud burned or properly disinfected with sulphate of copper. Only the most energetic action is likely to avail."

The director of the department of agriculture of Jamaica says in a report in 1905, "Mr. Cradwick has been engaged at intervals during the last two years in applying various remedies suggested by me. These experiments are still in progress, but I may say that I find the most effectual remedy is to spray with Bordeaux mixture at intervals of six to nine months until there is no trace of the disease." The mixture used was—

Copper sulphate	pounds	6
Lime	do	4
Water	gallons	50

The same report states that "in Grand Cayman and in parts of Jamaica planters have not been successful in growing coconuts because the young plants die off just at the time of the first flowering."

F. A. Stockdale, of the Jamaica station, reported in 1907 on the bud rot in Trinidad—

The youngest leaves appear to stand upright and do not unfold as they should. Afterward they turn yellow and then brown in color and the whole appearance is that of a withering tree with the center of the cabbage in an unhealthy condition. Sometimes this dying of the central bud could not be noticed until many of the lower leaves had turned yellow or brown. * * * After a time the terminal bud falls over, frequently leaving a ring of quite healthy-looking leaves at the top of a "headless" trunk. * * * This rot, in a diseased palm that is still standing, is invisible until the harder outer coverings of the bud are removed and it is found to be limited to the softer tissues. * * * A badly diseased bud is generally full of fly larvæ, etc., and the smell is awful. * * * Microscopic examination of the roots and stem indicated that they were quite normal, while those portions of the terminal bud, in the advancing margin of the disease, showed in most cases bacteria of different kinds, only in two instances was the advancing margin marked by a reddish discoloration produced by some fungus mycelium.

The few isolated cases in the Cedros district would indicate that this disease is not of a very infectious character, but large numbers have been killed out in the Siparia district, the spread being very rapid and apparently from the windward. I am inclined to the view that this disease is similar to the destructive disease of coconuts in Cuba, but as far as Trinidad plantations are at present concerned, it would appear to be largely due to unfavorable conditions of soil, drainage, etc. * * * With our present knowledge of the nature of the disease it is impossible to suggest a remedy for trees that are already infected, and therefore steps must be taken for preventing its spread. It is suggested that the top 4 or 5 feet should be cut from the diseased trees and buried deeply with lime.

Bud rot appeared in Ceylon in 1906, and is reported by Petch. It was found only in a small isolated patch of 10 acres, about 800 trees, of which 50 were dead or dying. The infected trees were 3 or 4 years old and old trees were not found ailing.

The first indication of the disease (in the case of young plants) is the withering of the youngest unfolding leaf. This turns brown and can be pulled

out of its sheath; it is then found to end in a soft brown mass. * * * The decay of this leaf is followed by that of the other fronds in succession, commencing with the youngest and proceeding outwards and downwards. The fronds decay and fall off until only a conical stump remains. If the dying fronds are removed and the bud exposed there will be found instead of the white cabbage a pale brown semiliquid mass which becomes dark brown with age and possesses an odor resembling that of a tanyard. In an advanced stage this rot includes the whole of the cabbage, and stops only when the woody portion of the stem is reached.

The organisms responsible for this decay are bacteria which are found in abundance in the rotting tissues; they are short, thick rods with rounded ends which form whitish colonies of slow growth on sugar agar. * * * These bacteria appear to find an entrance to the cabbage along the youngest leaf.

Diseased trees should be felled and the terminal bud burned. They should not be allowed to lie on the ground and become dry. * * * If steps are taken to remove dead and dying palms as soon as they are observed there need be no fear that this disease will become a serious menace to coconut cultivation. Felling and burning diseased trees is no doubt an expensive process, but it must be remembered that the work is of the nature of an insurance effected on the remaining trees, and its cost should be estimated in terms of the survivors instead of being compared with the actual value of the trees destroyed.

Close planting favors the spread of the disease, by preventing the evaporation of moisture from the young shoots.

The bud rot in East Africa is known from a letter cited by Petch, who quotes from it:

If the dead tree is not immediately destroyed by fire the disease rapidly spreads to the neighboring trees, and finally throughout the whole plantation.

A bud rot in Travancore is described in a letter in Ferguson's "All About the Coconut," and in the Indian Forester for 1894. It is a "decay of the tender, unexpanded leaf shoot. At first the lower end of the shoot grows discolored and, in a few days, general putrefaction of this and more or less of the cabbage ensues; the shoot droops and, in some cases, falls to the ground; the tree decays soon after and we are left lookers-on and losers. * * * It is only the most vigorous trees that are, as a rule, affected." The natives ascribe it to falling stars.

A bud rot of the Palmyra and other palms near the mouth of the Godaveri River is said to have been seen as long ago as 1894, but was not reported until 1904, and not on coconut until 1905. E. J. Butler published a careful study of this disease in 1907, at which time it infested a circle of about 14 miles radius.

The first symptom is a discoloration of a recently expanded leaf, which then turns white and withers; other leaves follow; the nuts fall prematurely and no more are formed.

The leaf sheaths of all diseased trees are marked by irregular, sunken spots in greater or less number. In the earlier stages * * * the spots are white; later on they become brown. They are always sunken and usually have somewhat raised edges. They begin in the outer sheaths and may be traced in through

succeeding ones toward the heart of the bud. As the inner layers are softer, the inside patches are often larger than those outside, and may even give rise to new patches which extend out again to the outside sheath. * * * The earlier patches are dry and either free from any appearance of a parasite on the surface or covered with a white mycelial felt. Very soon a wet rot follows, which extends with great rapidity in the delicate central tissues and converts the whole heart into a foul-smelling mass of putrefaction, in which everything is involved, and the original agent is lost sight of.

It is only in the early stages before the wet rot starts that the true cause can be made out. This is a fungus of the genus *Pythium*. * * * In quite young spots the mycelium is found only within the leaf tissues, where its threads extend between the cells, sending little branches or haustoria into them. * * * Later on it comes out on the surface, forming often a dense white felt of filaments bearing sporangia. There is no positive information as to its dissemination. No remedial measures intended to cure trees already attacked are possible.

It was first recommended by Butler that all infected trees be burned and that apparently healthy trees in infected districts be treated with Bordeaux mixture. A considerable force of men has been employed in the immediate restriction of the disease in this locality, and, as a result of experience under the local conditions, the use of fungicides has been given up. The work is now concentrated in the cremation of the sources of infection.

CROP-REPORTING SERVICE.

By The Statistician, *Bureau of Agriculture.*

Something over a year ago the Bureau of Agriculture organized a crop-reporting service with a view to bringing the farming classes of the Islands into closer touch with this Bureau. At the same time it was planned to bring them more closely into touch with the agents who buy their products, the people who consume the same, and persons with capital who are desirous of investing money in enterprises of an agricultural nature, making possible their mutual coöperation.

Later on, when this service has become more firmly established, the figures compiled in connection with same will prove of great value in making estimates each year with a view to ascertaining with a much greater degree of accuracy than has ever been possible before to what extent there has been an increase or decrease over preceding years in the production of the principal crops of the Islands.

The data from which crop statistics are now compiled are derived from various sources, but are taken mostly from the reports received from the municipal crop reporters in the provinces. These are received from the majority of towns in the Islands, but there are still a number of municipalities in which this Bureau has no representatives. The number from which reports are received is becoming larger every month.

The crop-reporting service has now reached a stage where the public should be allowed an opportunity to observe what is being done by the Bureau of Agriculture along this line. To this end there were embodied in the April number of the Philippine Agricultural Review extracts from all reports for the month of February received prior to the going to press of the Review. In the present number there appears a summary of the conditions existing in each province during the month of April made up from reports received for that month from the various municipalities, and in the future it is hoped to have each number of the Review contain something of this character, while during the proper seasons it is expected to embody tables showing the amounts of rice and other products of an important nature planted and harvested in each municipality.

The table giving lowest, highest, and average prices of products in each province should prove of considerable interest, and by comparing same

with the tables in the preceding numbers of the REVIEW a very good idea may be had as to the fluctuations in the local market prices in the different municipalities.

There are many inaccuracies in the reports received, on account of the following reasons: First, the large number of systems of weights and measures in vogue in the various provinces; second, the fact that in many muncipalities scales are practically unknown and the weight of an article is only arrived at by guessing; third, the indifference and opposition which is oftentimes met among the people by the correspondent in his endeavors to collect data for the monthly reports; and fourth, the fact that the work is as yet comparatively new, nothing of exactly the same nature ever having been attempted before in the Islands so far as is known. The correspondents encounter difficulties at this time which as they become more experienced in the work will gradually disappear and will permit their rendering more accurate reports than is possible at the present time.

It is very gratifying to note that, since the organization of the crop-reporting service, and in consequence of the work that is being performed in connection therewith, the people are gradually becoming acquainted with the work of the Bureau of Agriculture in the Islands. This is evidenced by the fact that the volume of correspondence with the provinces is rapidly growing larger, necessitating frequent increases in the clerical force of the Bureau.

In order to improve the character of this service and make the data compiled by the statistical division of a more accurate nature, it is desired whenever possible to have at least two correspondents in each municipality. All persons interested in agricultural statistics, especially teachers, merchants, Government officials, farmers, and others, are invited to become correspondents of the Bureau of Agriculture. The names of all such persons received will be placed on our list of correspondents and the mailing list of the PHILIPPINE AGRICULTURAL REVIEW. Report blanks will be sent them monthly to be filled out and returned to this office.

It might be stated incidentally that municipal reporters are looked upon as personal representatives of the Bureau of Agriculture in their respective localities and they are always given the preference whenever possible in the distribution of seeds and plants and the various bulletins published by this Bureau.

AGRICULTURAL NOTES, BY PROVINCES, FROM APRIL CROP REPORTS.

Albay.—Condition of crops in most municipalities is good. In Guinobatan 200,000 coconuts have been harvested. In Virac and Pandan considerable abacá has been harvested. Owing to lack of carabaos in Virac considerable difficulty has been encountered in cultivating the fields. Drought and mice have injured crops in a number of towns.

Ambos Camarines.—The majority of crops are in good condition. In several municipalities land is being prepared for sowing rice. On account of low prices the people of Tigoan seem desirous of abandoning the cultivation of abacá in favor of other crops. There is promise of a good crop of corn at Indan. Several municipalities report crops injured by drought and field mice. Labo reports damage to the growing rice crops by the recent heavy rains.

Antique.—Laua-an reports harvesting a small amount of copra, abacá, and sugar. Crops are reported in good condition, and 6,000 coconuts harvested during the month. A little surra and foot-and-mouth disease are reported.

Batangas.—The majority of municipalities report crops doing well. Sugar cane has been injured to some extent by drought in Balayan. Grinding of cane is still going on in a few municipalities. Reports indicate a considerable amount of foot-and-mouth disease, especially in Tanauan.

Benguet.—In some parts of this province crops are reported in good condition, while in others they have been injured by worms. The principal product under cultivation is sweet potatoes. In La Trinidad crops have been injured by excessive rainfall.

Bohol.—Reports indicate a large number of coconuts harvested. Amount of abacá being harvested is small, due to the low price. In Talibon, Antequera, Calape, Cortes, and Jetafe crops have been injured by drought, and in several of these municipalities by mice, bats, and insects. In most places growing crops are reported doing well, although in a few towns crops are rather below the average. Land is being prepared for sowing in Bilar, in which town foot-and-mouth disease prevails to some extent.

Bulacan.—Some towns report growing crops in good condition while others state that they are not doing so well. In Baliuag and Obando

crops are reported to have been injured somewhat by drought, while in Malolos and Paombong worms have done more or less damage. Hagonoy reports the best rice crop in several years. Three hundred cavans of corn and a considerable amount of sugar cane have been harvested in Baliuag. From Baliuag and Malolos reports show that a large number of animals have died from rinderpest and glanders, also from glanders in Santa Maria.

Cagayan.—Both drought and heavy rains have caused considerable damage to tobacco and other crops, especially rains in Gattaran and Enrile. Conditions of growing crops vary. In Abulug there have been a number of deaths among hogs. Enrile reports 13,000 quintals of tobacco harvested.

Capiz.—Considerable abacá and coconuts have been harvested during the month. Condition of growing crops is good in Badajoz, Dao, New Washington, Odiongan, Pontevedra, and Taft, while less favorable in other municipalities. Badajoz, Malinao, Buruanga, New Washington, Taft, and Pontevedra report a large number of deaths among animals from contagious disease.

Cavite.—Crops in Maragondon and Indan are reported in good condition. There have been some deaths of animals in Maragondon from rinderpest, in Carmona from foot-and-mouth disease, and in Indan 500 hogs, probably from cholera.

Cebu.—Excessive rainfall, drought, and worms have damaged crops in this province. A number of towns report harvesting coconuts, abacá, tobacco, and sugar cane. In Mandaue a number of animals have died from rinderpest; there has also been a large number of deaths from the same disease among hogs in the municipality of Balamban.

Ilocos Norte.—Crops are reported in rather poor condition in several municipalities, but are doing very well in Pasuquin and Laoag. Reports indicate more or less tobacco, maguey, corn, and sugar cane harvested. A great deal of the sugar cane in the Ilocano provinces is used for making a drink called "basi." This is a very popular drink among the people of that section. During April and the three months preceding same there have been approximately 1,000 cavans of mongos harvested.

Ilocos Sur.—Santa reports crops being harvested not giving very abundant returns due to scarcity of water during the growing period. Drought is reported to have injured crops in Bangued, Narvacan, Pilar, Santa, Sinait, Vigan and a few other places. The harvesting of sugar cane, maguey, coconuts, and tobacco is reported from a number of places. Deaths from contagious disease among hogs, carabaos, and cattle are reported from several towns.

Iloilo.—Reports from Oton indicate that mice and drought have caused considerable damage to growing crops, especially corn and tobacco. Otherwise crops are reported doing quite well. Coconuts constitute the principal crop harvested.

Isabela.—Drought and worms are reported to have damaged growing crops. Cauayan and Gamu report condition of crops fair.

La Laguna.—Paete reports abacá in danger of serious injury if the drought continues. The sugar-cane growing districts report more or less cane being harvested. Siniloan reports crops have been injured by birds and worms. The crops in most municipalities are reported as being in very good condition. There have been several deaths from contagious disease among animals in Majayjay. A disease stated to have the appearance of glanders is reported from Santa Rosa, but up to date of report there had been no deaths from same.

La Union.—In Gangar excessively hot weather prevails. Crops are reported good in Balaoan, Bangar, Bauang, Luna, and San Juan. Luna reports land being prepared for planting. In Bacnotan there have been a number of deaths among hogs.

Lepanto-Bontoc.—A good crop of maguey is reported from Angaqui this year. Maguey in Cervantes is in fine condition. Most of the towns in this province report growing crops in good condition.

Leyte.—Excessive rains have injured corn in Baybay. The harvesting of corn and tobacco is reported from Sogod. Report from Leyte indicates a large number of coconuts harvested there recently. Crops are good in a majority of the municipalities. Miranda reports that after the inoculations practiced by one of the inoculators of the Bureau of Agriculture rinderpest disappeared entirely from that town.

Mindoro.—The only crop reported harvested during the month is coconuts. Drought has injured the fruit. In Mamburao the condition of crops is reported good, and in Naujan only fair.

Misamis.—Mambajao reports considerable difficulty in cultivating the fields due to lack of work animals. A few deaths are reported in Langaran from rinderpest. Grasshoppers have done some damage to crops in Talisayan.

Moro.—Due to military operations in the vicinity of Lamitan everything is in a rather unsettled state. Ground is being prepared for sowing. Boston reports crops injured by excessive rainfall and wild hogs.

Nueva Ecija.—Crops are reported in good condition in Cuyapo, Gapan, and Licab. A large number of hogs are reported to have died in San Leonardo during the month. There have been a few deaths in Gapan among carabaos from rinderpest.

Nueva Vizcaya.—Rice is reported injured by insects and mice. In Quiangan the condition of rice, the principal product in that locality, is very good.

Occidental Negros.—Crops are reported to be doing well in most municipalities, except Jimamaylan, where some damage has been done to growing crops by grasshoppers. Due to the low price of sugar farmers are abandoning the planting of sugar cane in favor of such crops

as rice, corn, etc. The harvesting of sugar cane, coconuts, tobacco, and corn is going on in several municipalities. There is considerable foot-and-mouth disease among animals in some sections of the province, especially in the vicinity of La Carlota.

Oriental Negros.—In Dumaguete the farmers are experiencing great difficulty on account of shortage of draft animals. The price of abacá is very low. Growing crops in Lazi, Bacon, Tanjay, and Tayasan are reported in poor condition, while those in other municipalities from which reports have been received are doing better. Lowland rice is being harvested. Larena reports a large number of deaths among hogs from contagious diseases.

Palawan.—In Coron some injury was done to rice by mice and winds, and to coconuts by wild hogs. In one locality in the vicinity of Coron grasshoppers were numerous and no rice was sown this season. The price of carabaos is high on account of the demands of buyers from Manila.

Pampanga.—San Luis reports injury to crops by drought and worms. In most municipalities growing crops are reported doing well. A number of deaths of carabaos from rinderpest are reported from Porac, Bacolor, and Mexico. Contagious diseases are also said to have caused the death of several carabaos and a large number of hogs in the municipality of Candaba.

Pangasinan.—The principal crop harvested in Asingan was mongos. In a large number of municipalities crops are reported injured by drought, worms, etc. In San Isidro the custom prevails of planting the tobacco fields with corn after the tobacco has been harvested. A contagious disease among animals is reported from Alaminos, Bani, Binmaley, and Calasiao.

Rizal.—The condition of crops is backward due to lack of rain. Antipolo, Navotas, Binangonan, Pililla, Mariquina, and San Mateo report that crops are doing fairly well.

Samar.—Excessive rains, birds, mice, and grasshoppers have injured crops in San Julian, Tarangnan and Laoang, while drought has prevailed in other municipalities. Abacá, rice, and coconuts are reported as being harvested in a great many towns.

Sorsogon.—The low price of abacá and the poor rice crop just harvested has stimulated the planting of a greater variety of crops than heretofore in the municipality of Bacon. The planting of corn began during the month. The harvesting of coconuts, rice, and abacá is reported from many municipalities. Drought, mice, birds, worms, and insects have damaged growing crops more or less.

Surigao.—Condition of crops in the town of Surigao is reported to be below the average, while in Dapa, Gigaquit, and Tandag they are in good condition. In Gigaquit and Surigao large numbers of mice have injured rice in the fields.

Tarlac.—A contagious disease of animals prevails in Capas and has caused several deaths. Crops are not quite up to the average in Panique, while in Victoria and La Paz they are doing very well.

Tayabas.—In Guinayangan land is being prepared for planting rice. Most municipalities in this province report growing crops in good condition. A large number of coconuts have been harvested in some parts of the province during the month. In Lucban there are a large number of cases of foot-and-mouth disease, although there have been no deaths from same.

Zambales.—The condition of growing crops in Subic is reported to be fair, while in San Marcelino and Masinloc the condition is rather poor. A small number of coconuts has been harvested in Subic during the past month. There have been several deaths among carabaos in Masinloc from rinderpest.

RANGE OF PRICES OF PHILIPPINE AGRICULTURAL PRODUCTS.

Lowest, highest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the month of April, 1908.

Province.	Rice, per cavan.			Abacá, per picul.			Copra, per picul.		
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.
Agusan	₱2.00	₱2.00	₱2.00	₱7.50	₱7.50	₱7.50			
Albay	2.50	3.50	3.00	5.75	9.50	7.62	₱2.50	₱5.00	₱3.75
Ambos Camarines	2.00	3.50	2.75	4.10	16.50	10.30	4.00	7.50	5.75
Antique	2.00	3.15	2.57	15.00	25.00	20.00	5.50	9.00	7.25
Bataan	2.25	3.00	2.62						
Batangas	3.12	3.12	3.12						
Benguet	3.50	4.00	3.75						
Bohol	2.25	3.50	2.87	9.50	20.00	14.75	5.00	8.00	6.50
Bulacan	2.00	2.75	2.37						
Cagayan	2.00	3.50	2.75				10.00	10.00	10.00
Capiz	2.00	3.75	2.87	7.00	20.00	13.50	5.00	8.00	6.50
Cavite	1.87	3.20	2.53	20.00	21.00	20.50			
Cebu	2.00	3.50	2.75	12.00	24.00	18.00	6.00	8.00	7.00
Ilocos Norte	2.40	3.50	2.95						
Ilocos Sur	2.50	3.50	3.00						
Iloilo	2.12	3.00	2.56	8.00	22.00	15.00	6.00	6.50	6.25
Isabela	3.50	3.50	3.50						
La Laguna	2.50	3.37	2.93	7.00	18.00	12.50	5.00	6.00	5.50
La Union	3.25	3.50	3.37				4.00	9.00	6.50
Lepanto-Bontoc	2.50	3.50	3.00				3.00	3.00	3.00
Leyte	2.00	3.50	2.75	10.00	18.00	14.00	4.00	7.25	5.62
Mindoro	2.50	3.00	2.75	14.00	14.00	14.00	5.00	5.00	5.00
Misamis	3.00	3.50	3.25	7.50	9.00	8.25	5.50	5.80	5.65
Moro	1.50	3.00	2.25	7.00	16.00	11.50	6.00	6.00	6.00
Nueva Ecija	1.75	2.50	2.12						
Occidental Negros	2.50	3.50	3.00	15.00	26.00	20.50	4.50	7.50	6.00
Oriental Negros	2.50	3.25	2.87	8.50	16.00	12.25	5.00	7.50	6.25
Palawan	2.50	2.50	2.50						
Pampanga	2.40	3.00	2.70						
Pangasinan	1.80	3.50	2.65				5.00	10.00	7.50
Rizal	2.50	2.80	2.65						
Samar	1.50	3.25	2.37	9.00	15.00	12.00	4.50	7.50	6.00
Sorsogon	2.00	3.75	2.87	5.00	15.00	10.00	4.00	6.00	5.00
Surigao	2.00	2.50	2.25	11.00	13.00	12.00	4.50	6.25	5.37
Tarlac	2.00	2.50	2.25						
Tayabas	2.00	3.50	2.75	5.00	24.00	14.50	4.00	6.00	5.00
Zambales	2.50	2.50	2.50						

Lowest, highest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the month of April, 1908—Continued.

Province.	Sugar cane, per picul.			Tobacco, per quintal.			Corn, per cavan.		
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.
Agusan									
Albay	₱6.00	₱6.00	₱6.00	₱15.00	₱15.00	₱15.00	₱1.50	₱1.50	₱1.50
Ambos Camarines	5.00	5.00	5.00				2.00	3.00	2.50
Antique	3.00	4.50	3.75	6.00	35.00	20.50	2.00	3.00	2.50
Bataan	3.00	5.00	4.00				5.00	5.00	5.00
Batangas	2.50	4.50	3.50						
Benguet	6.00	6.00	6.00				4.00	4.00	4.00
Bohol	3.00	5.00	4.00	10.00	11.00	10.50	2.50	3.50	3.00
Bulacan	3.50	6.50	5.00	6.00	15.00	10.50	1.25	2.25	1.75
Cagayan	5.00	9.00	7.00	6.00	9.00	7.50	2.00	2.50	2.25
Capiz	3.00	3.00	3.00	4.00	44.00	24.00	1.00	3.50	2.25
Cavite	2.72	4.50	3.61	6.00	6.00	6.00			
Cebu	2.50	6.50	4.50	4.00	25.00	14.50	1.75	3.50	2.62
Ilocos Norte	2.00	6.00	4.00	4.00	17.00	10.50	1.00	3.00	2.00
Ilocos Sur	2.50	5.00	3.75	3.00	60.00	31.50	2.00	4.00	3.00
Iloilo	3.00	6.00	4.50	5.00	21.00	13.00	2.20	4.00	3.10
Isabela				12.00	12.00	12.00	2.00	2.00	2.00
La Laguna	2.25	4.50	3.37				2.50	3.00	2.75
La Union	2.50	4.00	3.25	3.00	9.00	6.00	2.00	3.00	2.50
Lepanto-Bontoc	3.00	5.00	4.00	3.00	8.00	5.50	2.00	2.00	2.00
Leyte	3.00	6.00	4.50	2.50	60.00	31.25	2.00	3.50	2.75
Mindoro							2.40	2.40	2.40
Misamis	4.00	4.00	4.00	20.00	30.00	25.00	2.75	3.12	2.93
Moro							2.50	2.50	2.50
Nueva Ecija	6.00	6.00	6.00	4.00	15.00	9.50	1.50	3.00	2.25
Occidental Negros	3.50	5.00	4.25	3.00	15.00	9.00	2.00	3.00	2.50
Oriental Negros	3.50	5.00	4.25	4.00	100.00	52.00	2.00	4.00	3.00
Palawan									
Pampanga	3.50	4.50	4.00				2.50	2.75	2.62
Pangasinan	3.00	7.00	5.00	2.00	33.00	17.50	1.60	4.00	2.80
Rizal	3.00	7.00	5.00				2.00	3.00	2.50
Samar	5.00	6.00	5.50	5.00	50.00	27.50	1.50	3.00	2.25
Sorsogon	3.00	7.00	5.00	4.00	8.00	6.00	1.25	4.00	2.62
Surigao	4.50	4.50	4.50	18.00	18.00	18.00	2.00	2.00	2.00
Tarlac	4.00	5.00	4.50	7.00	7.00	7.00	2.00	2.50	2.25
Tayabas	6.00	6.00	6.00	5.00	8.00	6.50	1.50	3.00	2.25
Zambales	5.00	5.00	5.00						

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VOL. I JUNE, 1908 No. 6

The Philippine
Agricultural Review

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1908

(Entered at the post-office at Manila as second-class matter.)

Bureau of Agriculture.

SEED AND PLANT DISTRIBUTION.

MAGUEY PLANTS.

For the guidance of those wishing to secure maguey plants from the Bureau of Agriculture the following statement is issued:

PLANTS FOR DISTRIBUTION.

The Bureau has ordered from Hawaii, with the promise of delivery in June, July, and August, 1,000,000 pole plants and 500,000 sucker plants.

The 60,000 nursery plants growing at Singalong will be ready for delivery in June and the 350,000 native nursery plants growing at Lamao will be ready for delivery in September and October.

DISTRIBUTION.

These plants will be distributed free of charge to parties requesting them, for their own use, as follows:

500 Hawaiian pole plants, or
200 Hawaiian sucker plants, or
400 native nursery plants.

No free distribution will be made of over 500 plants to one person.

Parties wishing larger quantities will be required to pay for them at the following rates:

	Per 1,000.
Hawaiian pole plants	₱6.00
Hawaiian sucker plants	18.00
Hawaiian nursery plants	20.00
Native nursery plants	6.00

Hawaiian nursery plants will not be sold in lots of over ten thousand to one person.

Parties ordering plants not on the free list should send post-office money order for amount of purchase.

Literature on the subject of maguey growing in the Philippine Islands can be secured from the Bureau of Agriculture.

KAPOK.

The Bureau of Agriculture now has for distribution a large supply of *Kapok* seedlings. These seedlings will be distributed without charge, and persons desiring the same should forward applications promptly.

G. E. NESOM, *Director of Agriculture.*

THE PHILIPPINE
Agricultural Review

VOL. I JUNE, 1908 No. 6

CONTENTS AND ILLUSTRATIONS.

CONTENTS.

ILLUSTRATION.

EDITORIAL.

AGRICULTURE IN HAWAII.

The leading article in the present number of the REVIEW is a report on agricultural conditions in the Hawaiian Islands. This article is a summary of a bulletin, "Agriculture in Hawaii," written by Prof. Jared G. Smith, special agent in charge of the Hawaii agricultural experiment station, and issued by the Hawaii promotion committee. The bulletin, which covers a wide range of subjects including both plant and animal industry, is a brief, but comprehensive, review of the present agricultural situation in Hawaii.

The principal crop of Hawaii is sugar cane, of which about 200,000 acres are planted. The rice industry is second in importance, yielding an annual crop worth about $2,500,000. Some 1,500 tons of coffee are produced annually and considerable areas of new land are now being planted in coffee. The cultivation of sisal hemp (maguey) is now well established, fiber of excellent quality is produced, and large areas suitable for this crop are available.

An important industry in Hawaii is the growing of tropical fruits.

Over 3,000 acres are now planted in pineapples, with ten or twelve canneries in operation and others in course of construction. More than forty varieties of bananas are grown, both for local use and for the export trade. Mangos, grapes, avocados, and other tropical fruits are extensively cultivated.

One of the new agricultural industries in Hawaii is the growing of rubber. Over 400,000 trees have already been planted, and new plantations are rapidly being established. A number of attempts have been made to establish a silk industry, and the Hawaii experiment station has carried on several experiments with silk. Vanilla plantations have been established near Honolulu, and the industry has been found to be a very profitable one.

As several of the principal crops in Hawaii are also staple crops in the Philippine Islands, and with soil and climatic conditions in many respects similar in the two countries, this review of the agricultural situation in Hawaii can not fail to offer many valuable suggestions to the Philippine farmer.

AGRICULTURE IN THE HAWAIIAN ISLANDS.

By JARED G. SMITH,
Special Agent in Charge, Hawaii Experiment Station.

PART I.

CLIMATE AND SOIL.

Although the Hawaiian Islands are within the tropics, the climate is subtropical. Summer maximum temperatures seldom range above 85° F., while at sea level, winter minimum temperatures never descend below 50°. The daily range averages about 13° and seldom exceeds 20°. The rainfall varies according to the seasons of the year and location. The northeast and east coasts of each of the islands are wet, the opposite sides of the islands dry. The rainfall in certain districts on the dry sides of the islands may not exceed 20 inches per annum, while on the wet side it may average as high as 30 inches per month. Frequent light local showers are characteristic of the Hawaiian climate. The rainy season extends from November to the end of March. Devastating winds are of rare occurrence. The average relative humidity is 72 per cent, which is low for the tropics. The valleys, plains, plateaus, gulches, and mountains all have a climate peculiar to themselves.

The soils of the Hawaiian Islands are mostly volcanic, the only exception being certain low-lying coastal plains, of coral origin. The soils differ widely from most of the agricultural soils on the mainland, and require different treatment. Their chief characteristics are their acidity, the exceptionally high percentage of iron, and their high percentage of nitrogen. Most of the soils are also rich in phosphoric acid and potash, but these are so locked up with the iron and other elements as to be entirely unavailable. As a general rule all of our soils require the use of fertilizers to secure the best results. The physical condition of the soils is such, and the prevailing slope of the agricultural lands is so high—on many of the islands averaging 500 feet per mile—that irrigation is required, except in regions with a high average monthly rainfall. Our soils do not retain moisture. The average content of nitrogen exceeds 0.3 per cent, or 6 tons in the soil to the depth of 1 foot on an acre of land. Hawaiian soils respond quickly to the application of organic and inorganic fertilizers, and, like all other new soils, improve under rational cultivation.

FIELD CROPS.

SUGAR.

Sugar cane is the principal crop of Hawaii. There are about 200,000 acres planted, one-half of which is cropped each year. The average yield is a little over 4 tons per acre. While sugar cane is mostly cultivated by large corporations under the plantation system, there are a number of farmers who grow cane on their own account to sell to the sugar mills. Sugar land is not readily obtainable. If new land must be cleared for planting it requires two and a half to three years to mature the first crop and market it; or an average of about eighteen months if land can be obtained which had been cleared or previously planted to this or some other crop. After the first plant crop is taken off, a ratoon crop follows in about fourteen months, followed by a second or long ratoon crop in eighteen months. It requires a capital of at least $100 per acre to grow sugar cane, but some plantations are capitalized as high as $600 per acre. With proper cultivation, fertilization, and good seasons a larger profit can be obtained from sugar cane than from most agricultural crops in temperate climates. Anyone coming here to grow sugar cane should have not only enough capital to carry the crop from planting to maturity, but also other resources. At the proper elevation, say 1,000 feet above sea level, white farmers can perform all of the labor in the cane field. A number of farmers in the Olaa district are profitably engaged in this industry, and suitable lands are available there and elsewhere.

RICE.

The rice industry is second in importance to sugar, there being about 12,000 acres devoted to the cultivation of this crop. The annual rice crop is worth about $2,500,000. While the Chinese control the rice industry, there are opportunities for the introduction and operation of labor-saving machinery such as harvesters and thrashing machinery. At the present time the methods of cultivation are Oriental. The seed is sown in nursery beds and the individual plants are transplanted by hand into the field. The sickle is used in harvesting, and much of the thrashing is still done with horses on stone thrashing floors. Preliminary experiments carried on by the Hawaii experiment station indicate that the use of improved harvesting machinery is entirely practicable, provided laborers can be obtained who understand the use of such machinery. Several good thrashing outfits could find ready employment, because the Chinese rice growers recognize the value of labor-saving appliances when properly operated.

There are two harvest seasons, or in some localities three, depending upon the variety of rice which is cultivated. There are spring and fall

varieties, just as in the case of wheat, and the alternation of spring and autumn varieties is well understood by the Chinese rice growers. The fall-ripening varieties, if planted in early spring, will only make one crop, continuing to grow without heading for ten months, or more. The same variety sown at the proper season matures in one hundred and twenty days. The cultivation of rice lands is continuous, there being on an average five crops in two years. Even with the expensive, primitive methods employed, rice cultivation is a very profitable industry.

COFFEE.

Hawaii produces annually about 1,500 tons of coffee. The value of the crop ranged from $270,000 in 1901 to $336,000 in 1906. About 4,500 acres are devoted to this crop and the average yield is 650 pounds per acre. From 24,000 to 30,000 bags are sold to the mainland markets and from 1,800 to 2,000 bags of the poorer grades are consumed in Hawaii. The average cost of production was 11 cents per pound in 1901, which has been reduced to about 7½ cents per pound in 1907. The present average value of the Hawaiian coffee crop is about 10½ cents per pound.

Hawaiian coffee is of the mild type and in general compares with the Mexican and Central American product rather than with the rank coffees of South America. Some districts produce a broad, flat bean, which when properly aged is not distinguishable from the best Old Government Java.

Coffee prices have been very low for the last seven years. The sudden fall in world's prices from 1898 to 1900 wiped out a great many farmers and plantations, but those who succeeded in living through the crisis, as well as those who have entered into the production of coffee under the new condition of prices, are running their plantations at a profit. If prices should rise, and especially could protection be assured the industry, there are great possibilities in coffee in Hawaii. This industry is an ideal one for white labor, the zone of coffee lands being one in which the climatic conditions are most favorable.

Coffee grows in practically all districts in the Islands at an elevation of from 1,000 to 3,000 feet. The Kona district, on the Island of Hawaii, has the largest acreage in this crop, and produces a bean which has made a name for itself in the mainland markets. There is also much coffee in the Hamakua, Hilo, and Puna districts. One of the methods of accommodation of cost of production to lower prices for the product is the utilization of the land between the coffee rows, for the first three years after a new plantation is established, for the cultivation of inter-crops such as land taro, soja beans, vegetables, and small fruits. During this preliminary period of growth, until the coffee tree comes into bearing, it is treated practically as a secondary crop upon the land. The cultivation

of the inter-crop is discontinued when the trees come into bearing, when, through increase in size, they have filled in the rows.

There is much variation in the distance at which the trees are planted; in the practice of shading the coffee, or growing it without shade; in the use of fertilizers; and in methods of cultivation. The young trees are set at the rate of from 650 to 900 per acre, depending somewhat upon the soil and the varying ideas of plantation managers. With so narrow a margin between the cost of production and marketing and the selling price of the finished coffee, there are wide opportunities for differences in methods of cultivation and handling.

The Hawaiian method of handling coffee is to pick the cherry as it ripens, the ripening period usually extending over several months. The cherry is run through a machine which removes the sweet outer pulp. The coffee seeds are surrounded by a thin, hard bladder-like sac, technically known as the parchment. As soon as pulped, coffee in the parchment is fermented in water-tight bins or trays of shallow construction. It is finally washed and dried in houses especially constructed for that purpose, or spread on drying floors in the sun. When the coffee is completely dried the parchment is removed and the green coffee is sorted, polished, and graded by machinery. It is then hand picked, and, when bagged, is ready for the market.

The opportunities in the coffee industry are good provided the prospective investor is satisfied with a low, but reasonably certain, return. The industry is now on a natural basis in Hawaii, the prices being governed more by the law of supply and demand and the world's production than by legislative protection. There has been a steady improvement in the market conditions as affecting our coffee crop. Demand is constantly increasing. Considerable areas of new lands are now being planted. Our coffee has, to some extent, established a market for itself, and the outlook of the industry on the whole is good.

SISAL (MAGUEY).

There is much land suitable for the cultivation of sisal on all of the islands of the group. Sisal is not in the stricter sense a cultivated plant, practically no cultivation being given after the plantation has been established, other than to clear out glue, lantana, and other weedy undergrowth. Sisal may be cultivated on any land not too thickly grassed, from sea level to an elevation of 2,000 feet. The controlling factor is rainfall and not elevation above sea level. While this crop has been cultivated in large areas in extremely barren and rainless country, such a location should not be chosen if cheap lands in a moderately wet district are available. Better results through more rapid growth and maturity are obtainable in locations where the rainfall ranges from 20 to 50 inches per annum than where it amounts to less than 20 inches.

Sisal is propagated from suckers or offshoots which appear at the base of the mature plants; and from pole bulbs, which follow the flowers instead of the seeds. The sisal plant almost never produces true seed pods, and even when these are produced the seed is seldom fertile. If suckers are used they may be transplanted at once to the field, but pole bulbs must be planted a year in fertile land to force their growth. While pole bulbs are sometimes set out in regular nursery rows, far enough apart to cultivate between them, a better style of plant for transplanting is secured by setting the bulbs in a compact mass, the individual bulbs not more than 2 to 4 inches apart. This makes a close, compact plant, easier to transport and handle than are the suckers or pole plants which have been set in nursery rows at wider distances. The object of nursery planting is to force growth in the early stages, shorten the period between planting and maturity, and add greater uniformity to the field.

Before planting it is best to clear the land of brush and weeds. Roadways should be laid out on such a contour that portable tracks may later be built through the plantation to facilitate the harvesting of the crop.

The plants are set in the field in regular rows from 7 to 9 feet apart and from 4 to 8 feet in the row, at the rate of from 800 to 1,100 plants per acre. It is a disputed question as to the amount of cultivation that can be profitably given, as well as the amount of preparation necessary before planting. Practice varies from picking up a circle 3 feet or more in diameter around the young plant, to no cultivation other than a hole made with a single blow of a mattock, loosening just enough dirt to pack the plant in position until it sends out roots.

Harvesting begins at the end of the third year after the nursery plants or suckers have been set in the field. The leaves are considered ripe for harvest when they have fallen from their rigid, erect position to a looser, horizontal one. From ten to twenty of the lower leaves are cut from each plant. In six months another crop is cut and so on until all the leaves have been taken. The leaves are bundled and hauled to the mill on carts or cars. The location of the mill should be decided upon before any planting is undertaken, being located either at the lowest point of the land or convenient to shipping facilities. The fiber is extracted from the leaves by high-power modern machinery especially devised for the purpose. Two systems of milling are in use. One type of machinery requires a supply of water which is trickled over the leaves while the fiber is being extracted. The other type requires no additional water supply other than the abundant juices of the leaf itself. As soon as the fiber is extracted it is hung on lines out of doors where the sunshine can dry and bleach it. When well dried and bleached it is made up into firm bales of 400 to 500 pounds and is ready for market.

In Hawaii the average life of the sisal plant is about nine years.

At least two crops can be harvested every year beginning with the third. As soon as the plant has thrown up its flowering pole it dies; the plant is then uprooted and another nursery plant set in its place.

Hawaiian grown sisal is pronounced by fiber experts to be of the best quality. It is superior to that produced in Yucatan, its only direct competitor being a limited supply which comes from German East Africa. The yield of fiber varies according to the number of plants set to the acre, and their size and vigor, but may be taken as averaging about 500 pounds to the acre per annum, or about 3,000 pounds per acre for the full life period of the crop. The fiber composes about 4 per cent of the weight of the leaf. In milling, the larger portion of the short fibers at the base of the leaf go into the waste. The average recovery of fiber in milling does not exceed $2\frac{1}{2}$ per cent of the total weight of the leaf and sometimes, through carelessness or badly adjusted machinery, not more than one-half of this amount.

The profitable disposition of the waste is somewhat of a problem. In Yucatan the waste is fed to cattle, a portion of the wages of the plantation laborers being paid in fresh meat. Every plantation in Yucatan runs a large herd of cattle. The milling takes place in the daytime and the cattle are turned into the mill yard at night, cleaning up thoroughly the pulp and waste fiber produced by the machines during the day. Cattle eat the sisal pulp readily and thrive upon it. In Hawaii the only use thus far made of sisal waste has been to dry it, clean out the short fibers, and curl them for use in the manufacture of mattresses. The sisal waste, or at least that part of it consisting of the short and broken fibers, is worth from 1 to $1\frac{1}{2}$ cents a pound as paper stock. The size of the plantation and the amount of waste will to some extent govern the methods of its disposal.

Fiber-extracting machinery is not expensive. The total cost of buildings and machinery for a sisal plantation of 500 acres should not exceed \$10,000. The outlook for this crop is a very good one. The total world's crop of sisal is less than 400,000 tons and the demand for sisal has been growing more rapidly than for Manila or other competing fibers. The prices f.o.b. Honolulu during the last five years have ranged from 6 to 8 cents per pound, although during the panic in the latter part of 1907 the price fell to $4\frac{1}{4}$ cents, bringing financial ruin to practically the whole Mexican Province of Yucatan. At this writing prices have recovered to about $6\frac{1}{2}$ cents and the trend seems to be upward. Those who have studied the fiber market of the world believe that both demand and prices are bound to increase.

The sisal crop is an attractive one for individuals or corporations owning large areas of cheap lands suitable only for grazing. There is practically no cost of cultivation other than the most meager preparation

of the land, the purchase of plants, setting them in the field, the harvesting of the leaf, and the shipping of the fiber. The industry is one which does not require the continuous employment of large numbers of laborers. It may be undertaken at a comparatively small capitalization per acre and may be carried on without the large monthly expenditures which must be incurred in the cultivation of more remunerative crops on better land. There is much land suitable for the cultivation of sisal on every one of the islands of the Hawaiian group.

COCONUTS.

While the coconut is one of the few species of palms native of Hawaii, being widely but somewhat sparsely scattered along all the coast lines of the group, its cultivation on an extended scale does not date back of 1904 or 1905. Renewed interest in the cultivation of this extremely useful tree is due in a large measure to the rapid increase in the demand for the oil and fiber. The value of coconut oil has long been recognized for soap making and as an illuminant. Coconut oil is the basis of a number of patented food compounds and butter substitutes, finding for the latter purpose an enormous sale within the tropics, because the melting point of the so-called "butter" manufactured from it is higher than for either pure butter or any of the oleomargarine compounds manufactured from animal fat. Not only is there a more or less legitimate field for the sale of artificial butter made from the coconut oil in hot countries, but its use as an adulterant is said to be practiced on an enormous scale in Denmark and other European countries where dairying is an important industry.

Coconut oil is being rapidly displaced as an illuminant by the cheaper petroleum. A characteristic of the oil is that it burns without smoking.

The value of the by-products, after the extraction of the oil from the copra, is also rapidly increasing. Coconut meal is becoming recognized as a concentrated feed of high value, and as an organic fertilizer equal to cotton-seed meal.

Coir, the fiber of the husk of the coconut, is in itself a valuable product. This fiber is used in the manufacture of ropes and cordage and is woven into bagging and matting. The stiff, harsher fibers obtained from the leaf stalk and from the mid-rib are used in the manufacture of all classes of brushes. In oriental lands the leaves provide materials for thatch and the trunks for house and bridge construction.

Another product of the coconut, not as yet utilized in Hawaii, is in the manufacture of a liquor or alcoholic beverage by fermentation of the sap obtained by bleeding the inflorescence. Elsewhere in the tropics the cultivation of the coconut for this purpose alone utilizes groves of hundreds of thousands of acres in extent. Sugar was formerly made from

this sap in large quantities, and even now the natives of many outlying tropical districts obtain the family sugar supply from this source.

The food value of the meat of the coconut has long been recognized. The shredded nut dried, with or without the addition of sugar, is used by housewives and confectioners the world over.

The coconut tree is a native of the tropics and is not known to occur at a distance of more than 28 degrees north or south of the equator. It is at its best farther to the south than Hawaii. While the tree has largely been considered a seashore plant, and while many authorities have considered that salt water was essential to its most perfect development, recent cultural experiments have demonstrated that a much more vigorous and productive growth may be obtained far inland.

The coconut tree demands above all things good drainage. It thrives neither in swamps nor on rocks. The roots are thick, fleshy fibers, there being no taproot. The roots seem to be especially adapted for the storage of considerable quantities of water, but wherever they reach the level of permanent standing water, or wherever stagnant waters rise above the level of roots already formed, these rot and the tree sends out new and shorter roots only as far as the perfectly drained and well-aërated soil extends. The tree is a heavy feeder, requiring cultivation and fertilization, giving best results where these can be augmented by irrigation or abundant rainfall.

Another factor is that the tree grows best in windy locations. Specimen trees in sheltered valleys, where the wind never strikes them, are more liable to be spindling and unhealthy. The requirements of the coconut may be summed up in having light and room in windy locations, where the soil is rich and well drained, and there is abundant artificial or natural irrigation.

In planting the coconut only the ripe nuts, carefully collected, from neither very young nor very old trees, should be taken. Nuts intended for planting should not be dropped or thrown from the tree, for if the shell is cracked within the husk germination will not take place. The husk contains enough moisture for germination, provided the seed bed is moist and half shaded. In drier locations the nuts should be planted on their sides and partially covered with loose, mellow earth, leaving about 2 inches of their surface exposed. The seed beds thus prepared should be kept moist, but not soaked. Germination takes place in from two to six months. As soon as the plumule pushes out through the husk on one side and roots are just appearing below, the seedling is ready to transplant to its permanent location.

Two methods of planting are in vogue. In India pits 3 to 6 feet across and 2 to 3 feet deep are dug 27 to 36 feet apart. These pits are filled with sand, manure, ashes, compost, rotted leaves, and rich soil.

The germinating seed is half buried in the center of the pit, and no further cultivation is given except to clear the weeds and no more fertilization than to utilize the coconut grove for pasture lands.

The newer method, and one which has been proved to give better results, is to plow the land and work the whole surface into the best possible state of cultivation. Frequent tillage follows with the planting of leguminous inter-crops and the addition of commercial fertilizers. The trees should never be planted closer than 30 feet, or at the rate of from 110 to 150 trees per acre. Close planting in rows, as seen in many native groves and in dooryards around Honolulu, and for that matter, all through the islands, is neither a satisfactory nor profitable method of coconut cultivation.

There is the widest variation in the number and size of coconuts borne by individual trees. Some trees may produce only a dozen nuts in the course of a year, others bear from 150 to 200, or more. Some trees begin to bear in their fifth or sixth year, others not for ten or fifteen years. The greatest profit in coconut cultivation will come by planting only nuts from trees known to have the most desirable qualities, both in early maturity and prolific yield. The trees continue to bear for fifty or sixty years or more, but during this time cultivation should be continued and the supplies of plant food taken from the soil returned in the form of organic or commercial fertilizers.

When the plantation begins to bear, the nuts are gathered as they ripen, the husk removed, either by hand or modern decorticating machines, of which there are many styles and patterns designed for the dual purpose of husking the nut and saving all of the fiber from the husk. The nuts are then split in halves and placed on drying floors in the sun. In twenty-four hours the meat curls loose from the shell and may be taken or emptied out. The meat is then dried for one or two days in the sun and finished off by artificial heat, or the meats are sliced by machinery and finished in steam-heated drying houses.

The Samoan coconut is considered the best variety for cultivation in Hawaii because it commences to bear at an earlier age and is more prolific than the Hawaiian tree. A coconut orchard in good bearing should yield from 10,000 to 15,000 nuts per acre per annum. Yields of nearly double these amounts have been obtained in other lands, but the Hawaiian average is considerably under this. The best practice would be not to produce copra for export but to extract the coconut oil on the plantation where the nuts are grown. The flesh of the nuts contains on an average about 35 per cent of oil. If this is extracted by modern commercial methods at least 30 per cent of the oil is recoverable and the cake, or waste, becomes a valuable by-product for feeding cattle or for returning to the land as fertilizer.

RUBBER.

The rubber industry is a new one in Hawaii, but already large areas have been planted. The variety planted is the Ceara (*Manihot glazovii*), a rapidly growing tree, native of southern Brazil. It makes its best growth in regions of high temperatures and high rainfall, but is adaptable to cultivation in semiarid regions, free from frost. Over 400,000 trees have been planted in Hawaii, and new plantations are rapidly being established. There are large areas available for its cultivation.

The tree has a habit of shedding its leaves, remaining bare for two or three months every year. The flowers accompany the young leaves which are put forth at the end of this resting period. The Ceara rubber tree makes an extremely rapid growth and seems especially well adapted to Hawaiian conditions. It is widely distributed throughout the group, importations having been first made fifteen to twenty years ago.

Preliminary tapping experiments, made by the Hawaiin experiment station, indicate a high yield of rubber of good quality, even from trees 3 or 4 years old. These preliminary experiments have shown that it is possible to secure from one-third to two-thirds of an ounce of rubber per day per tree for about half of the year.

Rubber is a product the price of which has been rapidly increasing because of the inadequate natural supply and increasing demand. While its cultivation is now being undertaken in all tropical countries, it will undoubtedly be many years before the production will have increased to such a point as to materially decrease the returns. Because of the rapid growth made by the Ceara tree, its response to cultivation, and its heavy yields in Hawaii, the establishment of a rubber plantation is one of the most attractive fields for large investments. Rubber growing is a business which will demand as much science, skill, and knowledge, together with business ability, as would any other new enterprise. But there is this in its favor, that rubber is one of the few of the world's agricultural products in the production of which there are still enormous profits, its cultivation being everywhere on a natural basis.

TOBACCO.

Tobacco experiments conducted by the Hawaii experiment station have been carried on for four years at a substation in the Hamâkua district on the Island of Hawaii. These experiments have been mainly in the production of cigar leaf. The results have been very favorable, the tobacco produced being of good color, texture, flavor, and burn.

The tobaccos of the Cuban type show themselves to be well adapted to cultivation in the islands and it is believed that there is a large acreage which will, in time, be utilized in this industry. The larger and more favorable tobacco districts, as indicated by the character of the soil,

amount of rainfall, and protection from high winds, are on the Island of Hawaii in the Hamakua, Olaa, Puna, Kau, and Kona districts. There is a considerable area of tobacco land on Maui in the Makawao and Kula districts and smaller areas on Oahu, Molokai, and Kauai. The striking characteristic of all Hawaiian tobaccos is their very excellent burning qualities.

While there is as yet no cultivation in Hawaii on a commercial scale, the outlook for the establishment of an industry is very good. While to a certain extent a market must be created before the production of filler types of tobacco is undertaken on a large scale, there is sufficient demand for wrapper leaf of the better qualities to make the cultivation of these types of tobacco an assured success, even though the crop must be marketed in open competition with the leaf imported into the United States from Cuba and Sumatra. The burning qualities of the Hawaiian grown leaf will sell it in any market. Should Hawaiian grown leaf, when cultivated on a field scale, show as high flavor as the Cuban grown article, it should not be difficult to create a market on the Pacific coast which would absorb all of the tobacco produced in these islands for many years to come. Hawaii has the advantage over either Cuba or Sumatra in that this crop is heavily protected, the duty on Cuban fillers amounting to 28 cents and on other foreign fillers, 35 cents. There is a protection of $1.85 per pound on wrapper tobaccos.

There are few agricultural products so highly protected as is tobacco, yet with a duty of $3,700 per ton against them the Sumatra tobacco growers sell annually 4,000 tons of wrapper leaf to the American consumer. At least a part of this ought to be grown in Hawaii.

CORN.

There is a good market for field corn in Hawaii at good prices. The local production does not equal the demand. Corn lands are available in several districts at elevations of from 2,000 to 5,000 feet and a number of farmers and ranchers have undertaken corn cultivation on a larger scale than formerly, having adopted improved agricultural machinery, new varieties, and modern methods of cultivation for the production of this crop.

The cultivation of sweet corn is more general. This vegetable is in the Honolulu markets during almost every month of the year. There is a good opening for the cultivation of standard market varieties of sweet corn for shipment to the Pacific coast markets from December until June, during the time of the year when only hothouse corn is on the market. The local demand is always good at good prices, especially corn of the improved types. Shipments recently made to San Francisco have brought an average price of about 50 cents a dozen

during December and January. Sweet corn ships well in cold storage. As stated above, it is capable of production at practically all seasons of the year. Farmers with a knowledge of market gardening can undoubtedly work up a good trade in the growing and shipping of sweet corn without the large investments of capital required in many other industries.

HAY AND FORAGE.

One of the most noticeable features of Hawaiian agriculture which invariably appeals to newcomers is that all the hay and grain used in this Territory is brought from the mainland, and that prices are very high. Baled wheat hay retails for from $30 per ton upward. Oats, barley, and other grain feeds are proportionately high in price.

On the sugar plantation the standard feed is the cane tops, California hay only being used for some of the draft teams. In the cities baled hay only is obtainable.

A number of attempts have been made to grow wheat for hay, but these have not been uniformly successful, and such production is only occasional, and has thus far cut no figure in the market. A grass has recently been introduced from South Africa which, however, bids fair to solve the question of local hay production. This is the Rhodes grass (*Chloris gayana*). This grass is a drought resistant species, of tall upright growth. It seems to be exceptionally well adapted to Hawaiian conditions. It makes a hay of a very excellent quality and yields very heavy, it being possible to harvest several crops during the year.

On lands capable of irrigation, alfalfa grows remarkably well, especially in suitable locations on the dry sides of the islands. At Waialae, near Honolulu, there is a field of about 300 acres which, under irrigation, yields thirteen crops per annum. Following the usual custom, this and other grasses and forage plants heretofore cultivated in Hawaii are fed green, but there is a good field for the cultivation of both alfalfa and Rhodes grass for supplying hay for the local markets.

Other grasses cultivated for forage are sorghum, which ratoons readily, so that a field planted with it often yields continuously for five or six years without replanting. The Guinea grass, a tall-growing bunch grass, is well liked although it requires a good deal of water and is rather a slow grower. Guinea grass is propagated by division of the roots, seed not being readily obtainable.

Para grass is widely cultivated under the name of "Panicum grass." It requires a good deal of water and rich land. Under proper conditions heavy yields are obtainable every two months throughout the year. This is a succulent, leafy grass, excellent for dairy purposes.

Johnson grass, locally known as "evergreen millet," or "Australian millet," is as much of a pest, where once introduced in Hawaii, as in

any other part of the world. It is much cultivated by dairymen who esteem it highly, because of its quick recovery whenever cut or closely grazed. The qualities which make it desirable from the standpoint of the dairymen or rancher, make it equally a pest in cane field or orchard cultivations. This grass was introduced into Hawaii under the name of "evergreen millet," and it was not recognized as being synonymous with Johnson grass until it had obtained wide distribution throughout the islands.

One of the best cultivated pasture grasses is *Paspalum dilatatum,* an Australian species. This is a bunch grass having about the same habit of growth as the orchard grass or cock's foot. It is a very strong, leafy grower; drought resistant, and has been widely planted by dairymen and ranchers throughout the group.

The most abundant pasture and lawn grass is the manienie or Bermuda grass of the Southern States. This is a rapid grower, especially in cultivated lands where it becomes a bad weed. It grows best from sea level to about 2,500 feet elevation.

At elevations above 2,500 feet many of the European and American pasture grasses have been introduced. Many of the grazing lands are now heavily stocked with English and Italian rye grass, Kentucky blue grass, fescue, smooth brome, white clover, mesquite, and red top, as well as with weedy grasses and clovers. Buffalo grass, which is the same as the St. Augustine grass of the Southern States, is a very valuable pasture and lawn grass at elevations from 1,500 to 2,500 feet.

The cultivation of the improved hay and pasture grasses and clovers is simply a matter of the proper elevation and rainfall, and new introductions of forage plants are constantly being made. There are excellent openings on all of the islands of the group for the cultivation of both Rhodes grass and alfalfa for hay.

While the cultivation of wheat for hay has not been uniformly successful, there are some of the more leafy varieties of dry-land rices which bid fair to form a satisfactory substitute for the imported article. A crop of 2 to 8 tons of hay can be secured from an acre of dry-land rice at least twice, and often three times, during the year. The cultivation of hay bids fair to be one of the most profitable of the minor industries of Hawaii.

(To be concluded in July number.)

WATER AND THE SOIL.

Rapid-growing plants require large and regular supplies of water. Plants use from 300 to 900 times their weight of water during growth. This water is pumped up through the roots and evaporated through the leaves and in passing up through the plant carries with it such food as may be in solution in the soil. As a rule, most agricultural plants will not live in standing water because the water keeps the air from the roots. Rice is an exception to this rule.

The water that plants use is that which remains in the soil after drainage has taken place. For example, if you take a bucket of sand and immerse it in water all the spaces between the grains of sand are filled with water. Now punch a few holes in the bottom and allow drainage to go on for three or four days. You say all the water is out of the soil, yet it is not all out for there is still a film of water around each grain of sand just as a piece of rock would be covered with water after dipping in water and allowing it to drip for a few minutes. This is called capillary water. The small root hairs, which are the active feeding roots of the plant, surround these grains of sand and take up this water by what is known as "osmosis." The control of this water is a very important factor in growing crops and improving soil.

Good agricultural soils hold capillary water equal to about 30 per cent of their weight. Plants are not able to use this water after it has dried out to about 12 per cent, so that when the soil is in the best condition for plant growth only about 60 per cent of the total moisture is available to the plant. During the dry season loss of water takes place by evaporation at the surface of the ground as well as through the leaves of the plant. Fortunately for the roots of the plant this water tends to maintain an even balance; that is to say, when a portion of the soil dries out, this water moves toward the dry place from the point of greatest moisture. An example of this is when the surface dries and water from below comes up to take the place of that lost by evaporation. When water has been taken out of the soil by the roots of plants other water moves toward this spot and of course carries with it soluble plant food, provided there is any in the soil.

The rapidity of movement of capillary water depends upon the size of the soil particles and the proportion of fine and coarse particles. Water will move more rapidly through coarse sand than through clay,

but as the water is held in the soil in the form of a thin film around the soil grains and there being more surface of the soil grains in a cubic foot of fine clay than in the same quantity of sand, there will be more water moved in the clay soil in a given time than in the sand, although it moves more slowly. Hence clay soils do not suffer from drought as much as sandy soils.

Most agricultural soils, when composed of the proper mixture of sand and clay, have a tendency, under normal conditions, to form small clusters of soil particles, just as small particles of sand tend to cling to larger ones, thus bringing about the best mechanical condition. This mechanical condition is destroyed when the soil is stirred while wet. This is called "puddling." Soil so handled, when exposed to the direct rays of the sum, becomes very hard. This condition is known as "baking," and simply means that the granular structure has been destroyed and the soil particles cemented together by drying. Soils allowed to bake in this manner are very difficult to put in good condition again. The mechanical condition may be improved by the use of shade crops, such as velvet beans, etc. The shade allows the slow action of capillary water to restore this cluster condition. Working when the land is in proper condition will also tend to improve the soil. Freezing is the method used in cold climates.

The movement of seepage water through the soil is governed largely by the mechanical condition of the soil. A soil composed of fine clay holds water very much as a jug, and if sufficient drainage is not supplied the plants suffer from the stagnant water. When the soil is open and porous this does not occur because the water goes on down through and does not keep the air out of the soil. But when water is allowed to run through the soil too freely it washes out the soluble plant food that has been liberated by natural methods. Soils that are too compact need drainage.

A controlling factor in soils, so far as moisture is concerned, is humus. Humus is partially decayed leaves, grass roots, or other organic matter in soils which, on account of the great number of cells, has a high water-holding capacity. The presence of humus makes the soil dark or black in color, so that in most countries a dark soil is regarded as a rich soil, but such is not always the case in these Islands.

All soils in tropical climates are more or less devoid of humus unless they have been recently cleared of their virgin forest or are formed of the washing from surrounding hills. The main cause of this absence of humus, however, is the fact that decomposition goes on constantly, and the excessive rainfall washes out the soluble matter.

The presence of humus not only adds fertility to the soil, but makes it more porous and open, thus increasing the water-holding capacity, which is an important factor during the dry season. The practice of

burning over the fields each year should be stopped and as much organic matter as possible turned into the soil. The removal of the forests and the burning out of the humus in the soil, and the consequent incrusting of the surface, are the main causes of the rapid rise of our streams and the washing of the land during the rainy season.

The character of the subsoil has considerable influence on the amount of moisture that will be available for the use of plants. As mentioned above the supply of capillary moisture is the governing factor in plant growth. Also only a limited amount of moisture is held in the soil, hence the storehouse below the surface must be large, so that capillary water may be drawn up from 6 or 8 feet below the surface. A thin layer of soil underlaid with gravel will suffer much from drought, while on the other hand, a deep layer of clay insures a good supply of moisture during the dry season, but provides poor drainage in the rainy season, when good drainage is essential except for rice and a few grass crops.

In order to furnish a constant supply of moisture during the dry season, it is necessary to irrigate. Irrigation water may be applied in two ways, namely, over the surface or by means of underground pipes, which is known as subirrigation, the water being allowed to reach the surface by capillary action. This is by far the best method because it does not cause "puddling," or baking of the surface, but it is too expensive for general use. It is adapted to garden crops on high-priced land.

In using the surface method, the water is conducted in ditches to the highest point of the field and allowed to run over the land by means of ditches between the rows of the growing crops. These ditches should be from 4 to 8 feet apart, depending upon the closeness of the soil. If the crop is rice or grass, the water may be allowed to spread over the field until the desired degree of saturation is obtained. These methods presuppose level or nearly level land.

Surface sprinkling is sometimes practiced. This method is in imitation of rainfall, but has several objections, first, the falling water compacts the soil and "puddles" it so that it bakes and necessitates frequent cultivation; second, it is expensive and wasteful of water because a large percentage of it evaporates before reaching the soil. On very sandy soils, however, where it is impossible to conduct the water over the surface, this method is valuable.

The best water to use in irrigation is river water, because it carries some plant food in the form of soluble salts or in the sediment and does not contain any injurious salts. Artesian water may be used, provided it does not contain anything injurious to the crop.

The amount of water to be used depends so much upon climatic conditions that very little information of much value can be given in a short article.

Water is measured, as a rule, by acre-inches, which means the amount of water in a basin of 1 square acre in extent and 1 inch deep. One acre-inch is equal to 27,111 gallons per acre and means the same thing as inches of rainfall. In a dry climate where evaporation goes on rapidly, much more water is required for a given crop than in a humid climate. For example, in Hawaii as much as 72 acre-inches of water have been used on sugar cane with good results. The crop, however, used only a small fraction of this water, the bulk being lost by percolation and evaporation.

The probable rainfall during the growing season of the crop must be taken into consideration. If sufficient water is applied to the crop to bring about the best conditions in the soil so far as moisture is concerned and a heavy rain should come just after, the crop would suffer from an excess of moisture the same as in the rainy season.

The kind of crop grown would also govern the amount of water used. Corn, for example, would require from 12 to 20 acre-inches, depending upon the kind of soil. Clay requires less and sandy soil more. This, of course, is not taking into consideration the rainfall. Corn, requiring only a short period in which to develop, would not require as much water as sugar cane, for example.

Mountain or upland rice would require about the same as corn, but rice that has to be flooded would require much more, as the water would have to be maintaind at a depth of from 6 to 15 inches on the land and this would have to be changed a number of times during the season. There is little loss by percolation on this kind of soil, however, as most rice lands are compact.

It requires much practice to know just how much water to use in a humid climate like that found in these Islands. The best guide is the "condition" of the soil, for such crops as corn, sweet potatoes, beans, and other crops that can not stand an excess of moisture, but for such crops as rice the height of the water is the only guide.

In countries where no rain falls and the composition of the soil is known, the amount of water to be used for each crop can be accurately stated in acre-inches.

SOME INFORMATION ON SILKWORM CULTURE IN THE PHILIPPINE ISLANDS.

By W. Schultze, *Bureau of Science.*

Practical experiments in silk culture have been carried on for some time by the Bureau of Agriculture in coöperation with the Bureau of Science with the view of determining the possibility of introducing the industry into the Philippine Islands. As these experiments are still under way, the following statements must be considered as being only tentative.

The mulberry, best adapted for food of the silkworms, is the variety known as *Morus alba* Linn. It grows wild in many places in these Islands, but without cultivation produces wood rather than leaves, and for maximum leaf production the tree requires cultivation of a special character. Mulberry trees are most advantageously raised by cuttings. The nursery bed should be in a sandy oil, the cuttings 15 to 20 centimeters long being simply stuck into the ground at intervals of 8 to 12 centimeters, and transplanted as soon as they produce three or four leaves. The end of the rainy season is preferable for starting the beds so that the cuttings may be transplanted before the ground becomes dry. Irrigation would be necessary during the dry season. Cuttings put in beds in the middle of the wet season are subject to rot. The cuttings should be set out from 2 to 2½ meters apart or 2,000 to 2,500 trees to a hectare (1 hectare equals 2.471 acres). Constant weeding and a single plowing or some similar cultivation is all that is necessary for the first two years, for mulberry trees grow readily on almost any soil provided the land is not too well drained. They require plenty of water, but too much of it is as disastrous as too little.

There are several species of wild silkworm found in these Islands—*Attacus atlas* Linn., *Attacus ricini* Boisd., *Antheraea semperi* Feld—but so far as known, there is no cultivated species here. Our experiments are carried on with *Bombay mori* Linn., Japanese "Spring worms" (white), and Bengal-Ceylon (yellow). The Japanese worms are accustomed to a colder climate and for this reason have not propagated well in these Islands, and, being a monovoltine species, great difficulty has been encountered in preventing the eggs from drying up during the long interval to the next year.

The Bengal-Ceylon species is a multivoltine which produces in Ceylon seven generations a year. Very good results were obtained with the species in the Philippine Islands; in fact eight and one-half generations were raised in a year. The quality of the silk of the Bengal variety is inferior to the silk of the Japanese species, although the quantity of the former makes up fully for the quality of the latter, as there is always a good market for silk.

With reference to the buildings suited to silkworm culture, it has been found that for a moderate investment nipa houses will answer the purpose. The house must be situated on somewhat elevated ground in order to keep the interior fairly dry. The roof should extend down about 1½ meters above the ground to keep the house cool and to keep out the rain, and should also extend far over the frame work of the building. The wooden or sheet-tin walls need to be only 1 meter high. All the other space up to the roof should be covered by fine wire gauze to keep out enemies of the worms such as wasps, lizards, mice, and rats. As such enemies would also enter through the nipa roof, a ceiling of wire gauze is also necessary. The feet of the racks which hold the trays must be put in small cement basins made in the ground which should contain water to keep the ants away from the worms.

The size of the trays used for the worms is 43 by 90 by 1.5 centimeters in the frames, which are made of pine wood. Three kinds of mesh are used for the frames—the first, of sinamay, with mesh 3 millimeters wide, for worms during the period from hatching to first molt; the second, of wire gauze, with mesh 7 millimeters wide, for the period from first molt to third molt; the third, also of wire gauze, with mesh about 10 to 13 millimeters wide.

The multivoltine species of silkworms, like our Bengal-Ceylon variety, have habits which make it absolutely necessary that cocoons which are used for further breeding be well and carefully selected as regards size and general hardness, shape (a perfect oval with a slight impression in the middle), and color (white as highest standard), etc. If such precautions are not taken, degeneration proceeds rapidly

The life history of our Bengal species from egg to egg is as follows, our fifth generation being taken as a sample: Eggs laid, August 4, (1907); eggs hatched, August, 14; first molt, August 17; second molt, August 20; third molt, August 23; fourth molt, August 25; pupated, September 1; adults enlarged, September 9.

On the same day on which the adults emerge, copulation takes place (about six hours); one day after, the females lay their eggs.

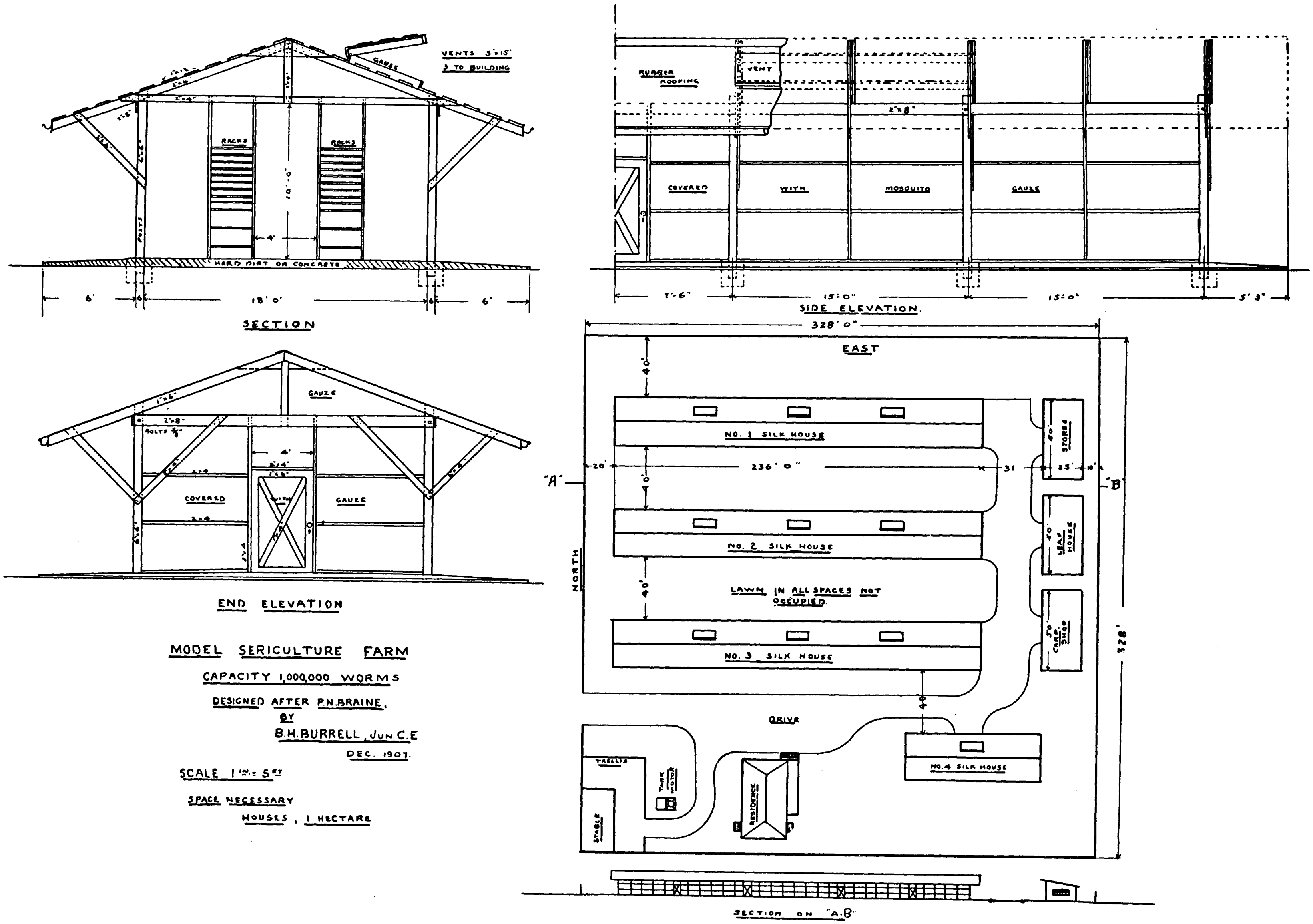
After about two days, the female is through with laying eggs. It is taken off and a note is made on the paper at what date, etc., the eggs were laid so that arrangements can be made when the eggs are ready to hatch. As soon as the newly hatched larvæ appear a young mulberry leaf is

placed over them. The young caterpillars crawl quickly onto the leaf. The leaf with the larvæ is then transferred to the sinamay tray, all larvæ which hatch together on the same date are kept together. The leaves should be evenly distributed over the tray, the side on which the caterpillars are feeding being turned upward. As soon as the leaves show sign of dryness, a new sinamay tray is placed over the first tray. On this second tray fine-cut young leaves are evenly distributed in a very thin layer. The larvæ at once crawl through the meshes of the lower to the upper tray and commence feeding on the fresh leaves. As soon as all larvæ have reached the upper tray, the lower one should be removed and cleaned for further use. During the period from the hatching to the first molt, the feeding as just described should be at least eight times a day. *As soon as larvæ show signs of molting new food should not be given until they are all past the molt.* The approach of the molting period is signalized by a general sleepy or stupid appearance and the worms at this time should not be disturbed. As the worms grow larger, the mesh of the superimposed trays should be increased in size accordingly. Practical experience will be the best teacher in regard to this. Clean, fresh food and clean trays are absolutely necessary to success in silkworm breeding. Cleanliness should be the keynote in the silkworm house; as otherwise diseases may arise.

When the full-grown worms become transparent and move about in a certain restless way, they should be transferred to a wire basket which contains suitable material for pupation. Various materials may be arranged for this purpose. Dry grass, broom corn, rice straw or similar material are suggested. The material may be arranged in various ways, the wire basket may be loosely filled or the straw may be tied in loose bunches and supported by strings at each end of the basket, the object being to furnish open spaces where the worms may easily spin their cocoons. Three days after pupation the cocoons may be taken out and the best ones selected for further breeding purposes, while the remainder may be reeled at once and used for spinning silk. If it is decided to keep them for future shipping or reeling, they must be killed by steam or dry heat.

One thousand silkworms need during the larval period from egg to pupation 18.20 kilograms of mulberry leaves. One thousand five hundred and ten fresh cocoons weight 1 kilogram, or 1,000 grams. One thousand grams of fresh cocoons gave 120.55 grams of good silk. In other words, 12 per cent of a given weight of fresh cocoons is good raw silk. Quotations for Philippine raw silk, so far as we have been able to find out, range from ₱5 to ₱8, the value being greatly influenced by the manner in which the silk thread is reeled.

For some time hybridization experiments between the Bengal-Ceylon and Japanese species have been carried on, the idea being to increase



VENTS 5"x15"
3 TO BUILDING
GAUZE
RACKS
RACKS
10'-0"
4'
HARD DIRT OR CONCRETE
POSTS
6'
18'0"
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SECTION
RUBBER ROOFING
VENT
2"x8"
COVERED
WITH
MOSQUITO
GAUZE
7'-6"
15'-0"
15'-0"
5'3"
SIDE ELEVATION.
GAUZE
2"x8"
4'
COVERED
WITH
GAUZE
END ELEVATION
MODEL SERICULTURE FARM
CAPACITY 1,000,000 WORMS
DESIGNED AFTER P.N.BRAINE.
BY
B.H.BURRELL, JUN.C.E
DEC. 1907.
SCALE 1 IN. = 5 FT
SPACE NECESSARY
HOUSES, 1 HECTARE
328'0"
EAST
40'
NO. 1 SILK HOUSE
20'
236'0"
31
25'
STORES
"A"
"B"
40'
NO. 2 SILK HOUSE
LEAF HOUSE
NORTH
40'
LAWN IN ALL SPACES NOT OCCUPIED.
CRAP SHOP
328'
NO. 3 SILK HOUSE
40'
DRIVE
TRELLIS
TANK MOTOR
RESIDENCE
NO.4 SILK HOUSE
STABLE
SECTION ON "A-B"

the quality of silk (color, etc.) and to form better shaped cocoons, as the Bengal cocoons are pointed at one end. The results obtained are excellent, as the hybrids are improved in every respect—size, shape, color, hardness, etc. One thousand hybrid cocoons (J. x C.) produced 83 grams of good silk. At the present time the third generation of hybrids is coming on.

The accompanying plan gives a good idea of a model silkworm farm with a capacity of 1,000,000 worms. A law against the importation by private concerns of live silkworms or eggs gives a protection against the introduction of diseases, which at present do not exist in the Philippine Islands. For this reason, the eggs, etc., can only be secured through the Bureau of Science or the Bureau of Agriculture.

AGRICULTURAL OPPORTUNITIES IN THE PROVINCE OF PALAWAN.

By EDWARD Y. MILLER, *Provincial Governor.*

LAND.

Large areas of rich agricultural land are available in various parts of the Island of Palawan. Most of this land is covered by a dense jungle and has never been cleared, while some has been cleared for the purpose of making "caiñgins" (small clearings), and then allowed to grow up in a dense jungle of caña bojo, brush, and small trees.

Owing to the nomadic habits of most of the inhabitants of Palawan the small fields planted in rice are abandoned after one or two years' cultivation and new "caiñgins" made. This is accounted for by the fact that the people have no agricultural implement except the bolo. They cut down the jungle at the beginning of the dry season and when the brush is dry, burn it. This leaves the ground clean and mellow, ready for planting.

After the first or second rice crop has been harvested the fields become covered with a dense growth of cogon (known as "lalang" throughout Malaysia), or other grasses. The sod formed by this grass is so dense that it can not be worked with a bolo and the Tagbanua is compelled to hunt a new field.

This process would appear to gradually destroy the land for cultivation, so far as the Tagbanuas are concerned. However, after five to ten years, if the land is good, brush and young trees will start, eventually killing out the grasses, and the land returns to jungle.

No claim of ownership is laid to any of this land by those who have cultivated it, and inasmuch as most of it can be easily cleared again for planting, and because the natives usually selected the choice bits of land for their planting, good opportunities are presented to homestead, rent, or buy parcels of this land from the Government for re-clearing and planting.

Southern Palawan, and especially the west coast, is fortunate in having a larger rainfall than is usually found in the Philippines and this fall is well distributed throughout the year. The lowland lying between the sea and the high mountains which extend through the center of the island is well watered, even during the dry spells, by the seepage of water stored in the mountains during the rains.

The conditions in south and west Palawan seem very similar to those of the west slope of the Malay Peninsula, where splendid results

are being secured from the planting of rubber, coconuts, pineapples, sugar cane, etc. North of Puerto Princesa plenty of good land is available for planting coconuts, cacao, tobacco, and abacá.

Very little land can be secured in the Calamianes and Cuyos Islands lying to the north and east of Palawan. These islands are more densely populated than Palawan and the small patches of good soil have been repeatedly cultivated until they are very much deteriorated. Some small tracts could be bought from the local residents, but this land would only be fit, at the best, for coconuts, and would not compare in richness with the land in Palawan. No large tracts of unoccupied public lands suitable for agriculture on a large scale exist in the Calamianes, Cuyos, or Cagayanes groups except barren hillsides and one tract on the Island of Busuanga, the question of the ownership of which is now before the courts.

A vast stretch of rich land lies south of Malampaya Sound in northern Palawan that will produce excellent returns in coconuts, cacao, abacá, and tobacco. Several low, flat islands lying near the south end of Palawan will furnish an enormous area for planting coconuts, but as they are practically uninhabited, laborers would have to be brought from other places.

PRODUCTS.

Coconuts produce well all through Palawan. Large returns per tree are secured on selected soil.

The largest and best producing cacao trees I have seen in the Philippines are growing in Palawan.

Palawan tobacco, although very poorly cured, is favorably known through the southern Philippines. Boats come from Panay, Negros, etc., to Palawan during the season for the sole purpose of buying tobacco.

From what I have recently seen in the Malay Peninsula, I am sure Para rubber can be successfully produced in southern and western Palawan.

Abacá produces splendidly if planted in the small protected valleys or ravines.

The natives raise for their own use a very good coffee, which produces well.

Southern Palawan has large level tracts suitable for raising sugar cane and cassava.

There is so much good land available in Palawan that prospective planters should not select any tract of land until they have decided what they will make their principal products and have satisfied themselves that the land selected is suitable for such products.

No one in starting planting on a large scale should devote all his energies to one product. At least two or three things should be decided upon, so that in case of the failure of one crop another can still pay the year's expenses.

LABOR.

Laborers are scarce in Palawan. Cuyo is the only thickly populated island in the province and the people there are very averse to leaving their homes. To carry on extensive work from the start, laborers (preferably families) should be brought from other islands. With proper treatment, after a time considerable Cuyono and Tagbanua labor can be secured.

TRANSPORTATION.

All traveling about Palawan is by boat. The long coast line and many tidal rivers reach all the agricultural land. Numerous harbors exist.

HEALTH.

Like all new countries covered with jungle, malaria is prevalent in Palawan about fresh clearings. However, as the land dries out and the decayed vegetable matter is consumed, the fever diminishes.

During the first two years of the existence of the Iwahig colony, the sick list was large among the colonists, while now that the men live in a large and well-drained clearing, malaria has almost disappeared.

Prospective planters should very carefully choose the site for the houses of their laborers. Well-drained clearings convenient to good water should be selected.

Care should be taken that all laborers receive good food, sleep under mosquito bars, and that a supply of quinine is at hand to promptly check any outbreak of fever.

NATIVES.

The people of northern Palawan, the Calamianes, Cuyos, and Cagayanes are not very industrious, but all are simple and kindly disposed to all who will give them just treatment.

The Moros and Palawanes of southern Palawan are peaceful, but must be carefully handled.

In connection with agricultural matters in Palawan it must be remembered that rinderpest has never appeared in the island, that large areas of public land are available for grazing, and that cattle can be raised to good advantage.

In most parts of Palawan trading for forest products can be carried on to good advantage by those who take up land in the more distant and isolated places.

This trading, if the mountain people are given fair treatment, can be increased to a point where the income will go far toward paying living expenses during the development of the land.

PUERTO PRINCESA, PALAWAN, *May 11, 1908.*

AGRICULTURAL NOTES.

The rice-planting season in most of the more important rice-growing districts of the Islands is now at hand and in consequence thereof the fields in such districts will for some weeks to come present a scene of great animation.

The prices of the majority of products intended for export still remain low and the people in many places prefer devoting their energies at the present time to the cultivation of such articles as rice and corn for which there is a large demand and for which the local market is willing to pay a very good price.

Animal diseases still prevail in many localities, one of these being foot-and-mouth disease which has presented itself this year in a more malignant form than it has for a long time. It exists to a more or less extent in practically all provinces in central Luzon and to a less extent in other parts of the Islands. Although the mortality among animals infected with this disease is not large, the fact that the rice-planting season is about to commence and the consequent need, therefore, of all available animals for plowing the fields, will make it rather inconvenient for the farmers and hinder them considerably in their work. There has been some complaint about this already and as the crop reports now being received do not seem to indicate that the present epidemic of foot-and-mouth disease is abating very rapidly, considerable fear is entertained as to the practicability of planting as much rice land as was thought would be planted this season.

In the following table there is shown the number of hectares of land planted, the number of hectares harvested, the yield and the condition of the principal growing crops in each province of the Islands, with the exception of Agusan and Palawan, during the month of May.

These figures are not complete, inasmuch as they refer only to those towns from which reports have been received. A very good idea may be had, however, as to the total amount of land planted and harvested and the condition of growing crops in each province by comparing the total number of towns in each with the number of towns from which reports have been received.

All municipalities from which reports are received are not represented in this table in view of the fact that, due to infrequent mail communication with some of the more remotely situated places in the Islands, reports did not arrive from such towns until after the manuscript for the REVIEW had been made up.

Crops planted and harvested and condition of same, taken from monthly crop reports for the month of May, 1908.

Note.—Attention is invited to the fact that rice should be understood as being in the unhulled state.

Province and crop.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Albay (reports from 9 towns):	*Hectares.*		*Hectares.*		
Abacá	22	Good	2,414	9,511	Piculs.
Coconuts		do		402,320	Nuts.
Corn	119	do	26	292	Cavans.
Sugar cane	106	Fair			
Ambos Camarines (reports from 23 towns):					
Rice	297	do	90	1,450	Do.
Abacá	191	Fair	1,337	5,755	Piculs.
Coconuts		Good		72,500	Nuts.
Corn	54	do	92	125	Cavans.
Antique (reports from 6 towns):					
Corn	50	do	355	1,780	Do.
Rice	170	do			
Abacá	16	do			
Coconuts		Fair		7,607	Nuts.
Bataan (reports from 4 towns):					
Coconuts		Poor			
Sugar cane		do			
Corn		Good			
Rice		do	72	480	Cavans.
Batangas (reports from 6 towns):					
Rice	4,050	do			
Sugar cane	2,500	do	900	13,500	Piculs.
Corn	500	Fair			
Abacá		Good	30	120	Do.
Benguet (reports from 11 towns):					
Rice	22	Fair	21	180	Cavans.
Sugar cane		do			
Corn	5	Good			
Coconuts		do			
Bohol (reports from 23 towns):					
Corn	4,307	do	60	200	Do.
Coconuts		do		816,675	Nuts.
Rice	1,363	do	31	2,150	Cavans.
Sugar cane	23	Fair	39	335	Piculs.
Bulacan (reports from 8 towns):					
Sugar cane	230	do			
Corn	275	Poor			
Rice		Good	700	22,400	Cavans.
Tobacco	75	Fair			
Cagayan (reports from 10 towns):					
Rice	311	Good			
Sugar cane	67	do			
Tobacco		Fair	100	1,000	Quintals.
Corn	599	do	379	250	Cavans.
Capiz (reports from 12 towns):					
Coconuts		do		485,000	Nuts.
Corn	544	do	28	250	Cavans.
Rice	1,978	Good			
Abacá	630	do	35	375	Piculs.
Cavite (reports from 5 towns):					
Abacá	.10	do			
Rice	795	do			
Sugar cane	1,010	Fair	15		
Corn	49	do			
Cebu (reports from 24 towns):					
Coconuts		Good		331,350	Nuts.
Tobacco		do	756	6,478	Quintals.
Corn	13,425	Fair			
Rice	263	Good	135	1,356	Cavans.
Ilocos Norte (reports from 6 towns):					
Rice	100	Fair			
Maguey	345	do	105	310	Piculs.
Corn	186	do			
Tobacco		Poor	500	1,000	Quintals.
Ilocos Sur (reports from 15 towns):					
Rice	880	Fair	600	18,000	Cavans.
Maguey	410	do	18	180	Piculs.
Tobacco		do	70	430	Quintals.
Corn	2,223	do	277	1,310	Cavans.

Crops planted and harvested and condition of same, taken from monthly crop reports for the month of May, 1908—Continued.

Province and crop.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
	Hectares.		*Hectares.*		
Iloilo (reports from 11 towns):					
Rice	2,245	Good			
Coconuts		do		51,000	Nuts.
Tobacco		Fair	406	1,165	Quintals.
Corn	2,000	do	710	8,150	Cavans.
Isabela (reports from 3 towns):					
Sugar cane		Fair			
Corn		Good			
La Laguna (reports from 12 towns):					
Rice	115	Fair	75	2,350	Do.
Sugar cane	240	do	10	500	Piculs.
Corn	148	do			
Coconuts		do		7,888,500	Nuts.
La Union (reports from 4 towns):					
Maguey	46	do	22	120	Piculs.
Sugar cane	136	do	32	822	Do.
Tobacco		do	90	1,415	Quintals.
Corn	320	do	10	100	Cavans.
Lepanto-Bontoc (reports from 13 towns):					
Coffee	12	do			
Rice	6,772	do	570	6,675	Do.
Sugar cane	15	do			
Corn	190	do	10	400	Do.
Leyte (reports from 13 towns):					
Abacá	1,281	Good	2,814	15,435	Piculs.
Corn	1,540	Fair	1,446	8,588	Cavans.
Rice	6	Good	671	2,555	Do.
Coconuts		Fair		664,091	Nuts.
Mindoro (reports from 1 town):					
Rice	200	do			
Abacá		do	5	20	Piculs.
Coconuts		do		25,000	Nuts.
Corn		do	5	30	Cavans.
Misamis (reports from 4 towns):					
Abacá	16	do	114	1,160	Piculs.
Coconuts		Good		164,340	Nuts.
Tobacco	112	Fair			
Corn	70	do	2	40	Cavans.
Moro (reports from 5 towns):					
Rice	51	do	51	1,275	Do.
Abacá	25	Good	52	806	Piculs.
Coconuts		do		101,800	Nuts.
Corn	6	Fair	2	24	Cavans.
Nueva Ecija (reports from 15 towns):					
Corn	1,481	Good			
Sugar cane		do			
Rice	452	do	20	400	Do.
Tobacco			80	160	Quintals.
Nueva Vizcaya (reports from 5 towns):					
Rice		Poor			
Tobacco		Good			
Coffee		do			
Occidental Negros (reports from 9 towns):					
Rice	1,960	do			
Sugar cane	2,110	do	1,220	20,200	Piculs.
Coconuts		do		58,200	Nuts.
Corn	2,263	do	6	60	Cavans.
Oriental Negros (reports from 7 towns):					
Coconuts		Poor		122,000	Nuts.
Corn	1,530	do	70	1,200	Cavans.
Abacá	5	Fair	55	620	Piculs.
Sugar cane		Good	33	1,900	Do.
Pampanga (reports from 9 towns):					
Rice	320	Fair			
Sugar cane	910	Good	155	1,350	Do.
Corn	535	Fair			
Pangasinan (reports from 19 towns):					
Rice	860	Good			
Coconuts		do		92,900	Nuts.
Corn	981	do	72	944	Cavans.
Sugar cane	21	do			

Crops planted and harvested and condition of same, taken from monthly crop reports for the month of May, 1908—Continued.

Province and crop.	Planted during month.	Condition.	Harvested during month. Area.	Quantity.	Unit.
Rizal (reports from 8 towns):	*Hectares.*		*Hectares.*		
Rice	80	Good			
Sugar cane	8	do			
Corn	205	do			
Samar (reports from 14 towns):					
Abacá	904	Fair	271	1,148	Piculs.
Coconuts		do		131,440	Nuts.
Tobacco	30	do	50	773	Quintals.
Rice	480	do	1,269	19,012	Cavans.
Sorsogon (reports from 13 towns):					
Rice		do	1,529	12,482	Do.
Abacá	162	Good	2,861	5,320	Piculs.
Coconuts		do		103,862	Nuts.
Corn	152	do	26	106	Cavans.
Surigao (reports from 2 towns):					
Rice	20	do	340	1,400	Do.
Abacá	200	do	500	1,500	Piculs.
Coconuts		Excellent		18,000	Nuts.
Tobacco	3	Good			
Tarlac (reports from 6 towns):					
Rice	410	do			
Sugar cane	90	do	50	600	Piculs.
Corn	155	do	25	150	Cavans.
Tayabas (reports from 9 towns):					
Rice	950	do	4,161	52,440	Do.
Abacá	10	do	75	188	Piculs.
Coconuts		do		746,600	Nuts.
Corn			25	2,045	Cavans.
Zambales (reports from 7 towns):					
Rice		Fair			
Coconuts		do		6,000	Nuts.
Corn	10	do	28	532	Cavans.
Sugar cane		do			

RANGE OF PRICES OF PHILIPPINE AGRICULTURAL PRODUCTS.

Highest, lowest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the month of May, 1908.

Province.	Rice, unhulled, per cavan.			Abacá, per picul.			Copra, per picul.		
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Albay	₱3.50	₱2.25	₱2.87	₱11.00	₱6.00	₱8.50	₱5.50	₱2.50	₱4.00
Ambos Camarines	3.50	2.00	2.75	10.50	4.00	7.25	6.00	3.50	4.75
Antique	3.12	2.00	2.56	25.00	18.00	21.50	9.00	9.00	9.00
Bataan	3.00	2.30	2.65						
Batangas	3.50	2.50	3.00	20.00	20.00	20.00			
Benguet	4.00	3.50	3.75						
Bohol	3.50	2.50	3.00	18.00	10.00	14.00	7.00	5.50	6.25
Bulacan	2.75	2.20	2.47						
Cagayan	3.75	2.00	2.87				10.00	10.00	10.00
Capiz	3.50	2.25	2.87	25.00	10.00	17.50	6.50	5.00	5.75
Cavite	3.25	2.85	3.05	18.00	18.00	18.00			
Cebu	4.50	2.00	3.25	23.00	12.00	17.50	8.00	6.00	7.00
Ilocos Norte	3.25	2.40	2.82				7.50	5.50	6.50
Ilocos Sur	4.00	2.00	3.00						
Iloilo	3.00	2.12	2.56	22.00	18.00	20.00	6.50	4.50	5.50
Isabela	3.50	3.50	3.50						
La Laguna	3.12	2.00	2.56	14.00	8.00	11.00	6.30	5.00	5.65
La Union	3.50	3.50	3.50				9.00	4.00	6.50
Lepanto-Bontoc	4.25	2.50	3.37				3.00	3.00	3.00
Leyte	3.50	2.25	2.87	15.50	8.50	12.00	6.00	4.50	5.25
Mindoro	2.50	2.50	2.50	12.00	12.00	12.00	4.50	4.50	4.50
Misamis	3.50	3.00	3.25	8.75	6.75	7.75	6.00	5.20	5.60
Moro	3.50	2.00	2.75	17.00	9.60	13.30	5.50	5.00	5.25
Nueva Ecija	2.50	1.75	2.12				10.00	10.00	10.00
Nueva Vizcaya	3.12	3.12	3.12						
Occidental Negros	3.25	2.50	2.87	22.00	18.00	20.00	6.50	4.50	5.50
Oriental Negros	3.50	2.50	3.00	15.00	3.00	9.00	7.20	5.50	6.35
Palawan	2.00	2.00	2.00				4.50	4.50	4.50
Pampanga	3.00	1.75	2.37						
Pangasinan	3.60	1.25	2.42				10.00	5.50	7.75
Rizal	2.75	2.00	2.37						
Samar	3.50	2.25	2.87	15.00	10.50	12.75	6.00	5.00	5.50
Sorsogon	3.50	2.00	2.75	14.00	6.00	10.00	5.50	4.00	4.75
Surigao	3.00	2.00	2.50	10.00	10.00	10.00	6.00	5.00	5.50
Tarlac	2.40	2.00	2.20						
Tayabas	3.50	2.00	2.75	18.50	3.00	10.75	5.00	3.25	4.12
Zambale	2.50	2.20	2.35						

Highest, lowest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the month of May, 1908—Continued.

Province.	Sugar, per picul.			Tobacco, per quintal.			Corn, per cavan.		
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Albay	₱6.00	₱6.00	₱6.00	₱20.00	₱8.00	₱14.00	₱4.00	₱1.50	₱2.75
Ambos Camarines	5.00	5.00	5.00				4.00	2.00	3.00
Antique	3.75	3.75	3.75	35.00	6.00	20.50	3.00	1.50	2.25
Bataan	5.00	3.50	4.25						
Batangas	4.50	3.00	3.75				3.25	3.25	3.25
Benguet	5.00	4.00	4.50				4.00	3.50	3.75
Bohol	3.00	3.50	3.25	12.00	5.00	8.50	4.00	2.50	3.25
Bulacan	6.50	3.75	5.12	12.00	12.00	12.00	2.25	2.00	2.12
Cagayan	9.00	6.00	7.50	9.00	6.00	7.50	3.00	2.00	2.50
Capiz	5.00	5.00	5.00	15.00	4.00	9.00	3.50	1.50	2.50
Cavite	4.50	2.50	3.50						
Cebu	8.00	3.50	5.75	30.00	4.00	17.00	3.50	2.00	2.75
Ilocos Norte	6.50	2.00	4.25	17.00	3.00	10.00	3.00	2.00	2.50
Ilocos Sur	4.00	2.00	3.00	60.00	3.00	31.50	4.80	1.00	2.90
Iloilo	6.00	4.00	5.00	21.00	5.00	13.00	4.00	2.00	3.00
Isabela	5.00	5.00	5.00	12.00	12.00	12.00	3.00	3.00	3.00
La Laguna	4.50	2.00	3.25				3.00	2.40	2.70
La Union	3.75	2.50	3.12	9.00	3.00	6.00	3.00	2.00	2.50
Lepanto-Bontoc	6.25	2.00	4.12	12.50	3.00	7.75	4.60	2.00	3.30
Leyte	5.00	4.00	4.50				3.50	2.50	3.00
Mindoro							2.40	2.40	2.40
Misamis	4.00	4.00	4.00	30.00	20.00	25.00	3.25	2.50	2.87
Moro									
Nueva Ecija	6.00	5.50	5.75	30.00	4.00	17.00	3.75	1.50	2.62
Nueva Vizcaya									
Occidental Negros	5.25	3.50	4.37	9.00	3.00	6.00	3.00	2.00	2.50
Oriental Negros	5.00	3.50	4.25				4.00	3.00	3.50
Palawan									
Pampanga	5.00	2.90	3.95				3.00	2.50	2.75
Pangasinan	5.00	3.00	4.00	10.00	2.00	6.00	4.00	1.50	2.75
Rizal	7.00	4.50	5.75				2.50	2.00	2.25
Samar	6.00	6.00	6.00	30.00	7.00	18.50	2.50	1.50	2.00
Sorsogon	7.00	3.00	5.00	15.00	8.00	11.50	4.00	1.50	2.75
Surigao									
Tarlac	5.00	3.60	4.30	7.00	7.00	7.00	2.50	2.00	2.25
Tayabas	8.00	6.25	7.12	5.00	5.00	5.00	2.00	2.00	2.00
Zambales	8.00	8.00	8.00	25.00	25.00	25.00	2.00	1.25	1.62

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Bureau of Agriculture.

SEED AND PLANT DISTRIBUTION.

MAGUEY PLANTS.

For the guidance of those wishing to secure maguey plants from the Bureau of Agriculture the following statement is issued:

PLANTS FOR DISTRIBUTION.

The Bureau has ordered from Hawaii, with the promise of delivery in June, July, and August, 1,000,000 pole plants and 500,000 sucker plants.

The 60,000 nursery plants growing at Singalong will be ready for delivery in June and the 350,000 native nursery plants growing at Lamao will be ready for delivery in September and October.

DISTRIBUTION.

These plants will be distributed free of charge to parties requesting them, for their own use, as follows:

500 Hawaiian pole plants, or
200 Hawaiian sucker plants, or
400 native nursery plants.

No free distribution will be made of over 500 plants to one person.

Parties wishing larger quantities will be required to pay for them at the following rates:

	Per 1,000.
Hawaiian pole plants	₱6.00
Hawaiian sucker plants	18.00
Hawaiian nursery plants	20.00
Native nursery plants	6.00

Hawaiian nursery plants will not be sold in lots of over ten thousand to one person.

Parties ordering plants not on the free list should send post-office money order for amount of purchase.

Literature on the subject of maguey growing in the Philippine Islands can be secured from the Bureau of Agriculture.

KAPOK.

The Bureau of Agriculture now has for distribution a large supply of *Kapok* seedlings. These seedlings will be distributed without charge, and persons desiring the same should forward applications promptly.

G. E. Nesom, *Director of Agriculture.*

THE PHILIPPINE
Agricultural Review

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CONTENTS AND ILLUSTRATIONS.

CONTENTS.

ILLUSTRATIONS.

EDITORIAL.

PHILIPPINE FOREIGN COMMERCE.

The "Report on Philippine foreign commerce in the calendar year 1907," published in this number of the REVIEW, is, in part, a summary of agricultural conditions in the Islands for this period. This report shows improved commercial conditions in both import and export trade. Imports exceed by $4,050,042 those of 1906, and increased export values amount to $454,975.

In considering the import trade of the Islands, the fact of especial interest to the Philippine farmer is that one-third of the total imports come under the general head of foods, drinks, and food-animals. A large part of these imports are products that could be produced wholly, or in part, in the Islands.

The largest single item of value under this group is rice, the imports of which amounted to $4,166,744. The imports of rice show an increase in value of $174,831, this increase being due to exceptionally high prices as shown by the fact that the quantity of rice imported in 1907 was less than in 1906. The cattle trade amounts to $1,119,638, of which China furnished, in 1907, 90 per cent. The total meat trade amounts to

$886,924, one-half of which comes from Australasia. Vegetables are imported to the amount of $561,116; dairy products, $478,585; coffee and cacao, $343,288; and eggs, $243,810.

Of the export trade the four great Insular staples—abacá, sugar, copra, and tobacco, which constitute 95 per cent of the total exports show a gain of only $13,314. Of these four staple products copra shows a considerable increase, abacá a small gain, and sugar and tobacco considerably reduced values.

The most encouraging feature of the export trade of the Islands is the increased trade in various minor products, such as maguey, ylang-ylang, coconut oil, etc. Of these minor products maguey is of the first importance. The exports of maguey show a steady growth from year to year both in quantity and value, and it seems probable that this fiber is destined to become one of the important export products of the Islands.

DEVELOPMENT OF DAVAO.

The improvement of agricultural conditions in the district of Davao during the past few years has been watched with interest by all persons concerned in the welfare of Philippine agriculture. It is especially gratifying to read, at the present time, the optimistic and encouraging report of the secretary of the Davao Planters' Association. From other hemp-producing sections one hears only of low prices and hard times, but, according to this report, "the prevailing spirit among the pioneers who have cast their lot with the fortunes of Davao has been one of optimism and enthusiasm."

One of the important factors that has contributed to the success of the work in Davao has been the Planters' Association. This association, organized early in 1905, includes in its membership practically all of the Spanish and American planters in the district. The purpose of the Planter's Association is the securing of unity of effort among the planters and the promoting of planting interests, both individual and collective, within the district.

In Davao, more than in any other part of the Islands, we have an opportunity to observe what results can be obtained with abacá where favorable soil and climatic conditions are combined with high cultivation, irrigation, and wise and careful management. The returns of the Planters' Association indicate an average yield of 18 piculs of fiber per 1,000 hills of hemp (1 hectare), with yields of from 30 to 40 piculs per hectare under exceptionally favorable conditions.

At one time it appeared that the labor situation might seriously hamper the work of the planters, but conditions have been so greatly improved that there is now no cause for anxiety. The wild, half-savage hill tribes

now contribute a considerable supply of labor, and laborers are also being brought in from the Visayan Islands. The more general use of labor-saving machinery will permit of development without greatly increasing the demand for labor.

The Davao pioneer has had by no means an "easy road to fortune." The first settlers have gone out into the jungle far from towns and in many cases miles away from their nearest neighbor. Transportation has been difficult, labor none too plentiful, and in many instances the work was new and untried. Superior to these obstacles, however, with indomitable will and a fine enthusiasm these men have kept to their task and now seem in a fair way to reap a rich reward. This work has been no exception to the rule that great results can not be obtained without great sacrifice. For those who have laid down their lives the most enduring monument will be the "new Davao" which they have helped to create.

AGRICULTURE IN THE HAWAIIAN ISLANDS.

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PART II.

COMMERCIAL FRUITS.

PINEAPPLES.

Over 3,000 acres are now planted in pineapples, and it is estimated that there will be at least 10,000 acres in bearing within five years. The industry is on a very profitable basis. Large areas of land are still available, and there is no immediate probability of overproduction, as the markets of the United States will absorb unlimited quantities, not only of fresh but of the canned fruit. There are pineapple lands on all of the islands. The requirements are good drainage, shelter from winds, and a rainfall from 40 to 80 inches per annum, although the pines grow to perfection with double or treble the maximum here stated. The plants grow better on the red soils than on the brown or black. The best areas thus far brought into cultivation are at from 400 to 1,200 feet above sea level.

Clean cultivation is practiced. The land, if virgin sod, is plowed, cross plowed, and harrowed, and is planted with suckers or tops. The plants are set out at the rate of from 4,000 to 10,000 per acre. Three methods of planting are in vogue. Where the object is to grow fresh fruit for shipment the plants are set out in rows 6 feet apart, 20 to 24 inches in the row, or at the rate of about 3,600 plants per acre. This distance between the rows permits the cultivation of the crop with horse labor and machinery, and leads to the production of large attractive fruits. The plants set out at this wide distance often produce fruit averaging from 6 to 9 pounds. For canning purposes smaller fruits are more desirable. The plants are set 2 feet apart in rows 4 feet apart, at the rate of about 6,000 plants per acre, or in rows 2½ by 2 feet, requiring from 8,000 to 10,000 plants to an acre. In either of the closer methods of planting it is necessary to leave roadways through the plantation for convenience in gathering the fruit. If there is a good stand and the plants are in a healthy condition, about 90 per cent may be counted on

to bear fruit in from eighteen to twenty-four months after the plants are set in the field.

Where an acre of land is planted with 6,000 pines the first crop will average about 10 tons. The second or ratoon crop, will be somewhat higher because many of the plants produce two suckers which bear fruit. The yield of the ratoon crop of pines has run as high as 20 tons per acre under exceptionally favorable conditions.

The cultivation consists in keeping the soil between the rows in good condition and free from weeds. The pineapple is a crop that gives best results with perfectly clean cultivation. Where the plants are set in rows 4 feet apart, all of the cultivation for the first twelve to fifteen months may be done with horse labor. When the plants flower, and as they begin to ripen their fruits, the leaves of the plant spread out so that it is no longer possible to take machinery between the rows, and after that time hand labor is necessary. The cost of production, provided the plants can be secured at a reasonable figure, is less than $15 per ton of fruit, and in some cases less than $10 per ton. Cannery prices for the fruit range from $20 to $27 per ton. If the fruit is shipped fresh to the Pacific coast or Eastern markets, prices as high as from $200 to $240 per ton may be realized.

The variety of pineapples chiefly cultivated is the smooth Cayenne, although the red Spanish, a smaller and more woody variety, finds favor with some growers. The quality of the Hawaiian pineapples is superior to that of any other pineapples which reach the American market.

The Hawaii experiment station has conducted a number of shipping experiments with this fruit. Enough has been done to show that fruit which is carefully handled and packed will stand shipment at least 5,000 miles.

The 1907 crop of Hawaiian pineapples is valued at more than $500,000 and it is estimated that the crop of 1912 will amount to 100,000 tons or more. Pineapple cultivation affords a wide field to practical agriculturists both in the growing and marketing of the fruit. The markets for our product are world-wide, and are capable of almost indefinite expansion. The principal Hawaiian crop ripens from June until September, a period during which there are no other pineapples in the American market. There is a second crop from November to February.

There are ten or twelve canneries now in operation in Hawaii and others in process of construction, or to be built during the coming season. Large areas of land are available for the cultivation of this crop. Lands may be leased at from $5 to $20 per acre, or can be purchased at from $75 to $500 per acre. The demand for the canned fruit is greater than it has been possible to supply, on account of the superior quality of the pines, and it is probable that the demand will continue to increase for a good many years to come.

BANANAS.

Bananas require a rich soil, abundant rainfall, or irrigation in connection with a good drainage and protection from high wind. While there are more than forty varieties of bananas in cultivation in Hawaii, only two of these are of commercial importance. These are the Cavendish, or Chinese dwarf bananas, and the Jamaica, or Bluefields. There are a number of table varieties such as the apple, the lady-finger, the Jamaica red, and the Brazilian, the ripe fruit of which is considered much better than that of either the Cavendish or the Bluefields. These table varieties and a number of native cooking bananas find a considerable market locally. Some of these will undoubtedly, in the course of time, become popular on the mainland.

The Chinese banana is one of the most largely grown. It is propagated by means of suckers or offshoots which spring from the base of the plants. These are removed and transplanted direct to the place where they are to grow. The suckers are usually set at intervals of about 10 feet each way. The ground should be plowed and put in good condition before the bananas are set out, but if plowing is not practicable the suckers are set in holes 2 to 4 feet across and 2 feet deep, the holes being filled with surface soil, rotten leaves, or soil mixed with manure. The banana fruits in from fifteen to twenty-four months from the time of planting. Each plant bears only one bunch of bananas. When the bunch has matured the tree is cut down, and one or two of the suckers which have matured at its base, are allowed to replace it. In this way there is always a succession of banana plants coming on. A number of crops may be harvested from a single planting, although it is a matter of dispute among growers as to how long this suckering may be permitted without replanting.

The Chinese dwarf banana yields from 700 to 900 bunches per acre per annum. On new land the bunches are large and full, and the growth of the plants rapid and vigorous. Continued cultivation of bananas on the same land for a number of years tends to decrease the production through diminishing the size of the bunches.

The Jamaica, or Bluefields, banana was introduced into Hawaii in 1903. It is the chief banana of the American trade. It stands shipping better than the Cavendish, as the bunches require no wrapping. The fruits are larger, well placed on the bunch for convenient handling, and the bunch itself is larger and more compact than that of the Chinese, or Cavendish, variety. The plant is larger than the Chinese, and requires about twenty-four months to begin bearing. The Jamaica has not been cultivated in Hawaii long enough to say what the yield per acre will be.

The Chinese banana can be produced at a profit at 50 cents per bunch.

This price includes the wrapping with hay or dead banana leaves. The cost of shipment to San Francisco is about 35 cents per bunch, so that if the banana sells in the San Francisco market for $1 there is a small margin of profit. The price often ranges as high as from $1.75 to $2.50 per bunch; and of course, at such prices the business is extremely profitable.

The banana is a cheap fruit, the market for which depends largely upon the abundance or scarcity of apples and other cheap fruits. When there is a shortage in the apple crop the market is good and the prices high, so that there is a considerable margin of profit. If, however, there is a glut of deciduous fruits, the demand for bananas almost invariably falls, so that the margin of profit diminishes. There is a good opening in Hawaii for the cultivation of bananas by anyone having experience in the growing and especially in the handling and marketing of fruits. While competition is sometimes keen, there is a possibility of anyone having business ability working up a good trade in this fruit, the cultivation of which is not at all difficult.

MANGOES.

The mango has been called the king of the tropical fruits. With its unique forms, rich coloring, and luscious taste, it is certainly deserving of the high rank thus conferred upon it. The mango is a large, well-shaped tree, which grows best in good soil with abundant moisture. Its dark green foliage and compact habit of growth make it one of the most prominent trees in any tropical landscape. While the mango is a native of India, it is now widely distributed through all tropical lands. The mango is propagated from seed, and by inarching and budding. As in many other cultivated fruits, the seeds do not come true, so that the only sure way of getting an orchard of a given variety is to bud or graft. In Hawaii the mango usually flowers in January, or from December to March, depending somewhat upon the condition of the weather and the location of the trees in relation to elevation above sea level. The mango season lasts from about June until August.

For home use the fruit is allowed to ripen upon the tree, but for marketing purposes it is necessary to gather the fruit while yet firm. If picked when full grown its excellent flavor is retained. The mango ships wells in cold storage. The Hawaii experiment station has made successful shipments to New York and to Manila. They are commonly shipped from the West Indies to London, and even from India to the same market, arriving in good condition. If picked without bruising, properly packed, and transferred direct to cold storage, the mango can be shipped to any point which can be reached within from thirty to thirty-five days from the point of origin.

The varieties of mangoes are very numerous. There are said to be over 500 in India alone. Where this fruit tree is propagated from seedlings, new forms are constantly arising.

The rarer varieties of mangoes, especially the so-called Indian and Manila strains, and some of the improved sorts which have been introduced from the West Indies, find a very ready market locally, selling at good prices; and it is believed that the returns from systematic mango cultivation would be large, even were the grower to depend wholly on the local trade and not attempt to ship to the mainland markets. The New York market receives considerable shipments of mangoes every year from the West Indies and southern Florida. There is a growing demand for this fruit in the markets of the Pacific coast. The tree begins to bear in from five to seven years from seed.

AVOCADOS.

The avocado, or alligator pear, is a tropical fruit for which the demand is constantly increasing in the mainland markets. The tree is of medium height, and a rapid grower, producing fruits within four or five years from seed. The trees continue fruit production for many years. The avocado responds readily to care and cultivation, these having an influence on not only the size and number of fruits but a very marked influence on its flavor.

The Hawaii experiment station has made a number of shipping experiments with this fruit and has demonstrated that the avocado may be shipped in cold storage, if properly packed, to any market in direct ocean communication with Hawaii. These fruits sell in the Honolulu markets at from 5 to 20 cents each and in the San Francisco markets from $2.50 to $4 per dozen, the demand especially in the latter market, being usually greater than the supply.

The avocado is a salad or breakfast fruit, and is not suitable for eating out of the hand. The flesh is oily, with a delicate nutty flavor. The fruits are cut in half, lengthways, the large seed removed, and the flesh is eaten with a spoon after being dressed with salt and pepper, or vinegar, or sugar. It is very excellent in salads, either alone or in combination with other fruits, celery, or nuts. It is also prepared in cocktails with various sauces or is eaten with soups. Anyone who has acquired the taste for the avocado will never tire of eating this healthful fruit.

There are many openings for the cultivation of the avocado commercially on an orchard scale. The trees often bear from 200 to 500 fruits, which, if of a good variety, are salable in the Honolulu market for an average of 6 cents to 10 cents each on the tree. The tree is readily propagated by both budding and grafting. There are upwards of forty

varieties of avocados in the Hawaiian Islands, including many of the best varieties grown in other tropical lands.

The tree requires rich soil, a fair amount of water, and protection from winds. It grows and fruits in all districts of the islands from sea level up to about 1,800 feet.

VEGETABLES.

The production of garden vegetables for the local market is almost entirely in the hands of Chinese and Japanese gardeners. However, as it is a tendency on the part of most Orientals to plant over and over again using seed of their own production, vegetables of improved varieties grown from imported seed find good sale in competition with the ordinary run of product at fair prices. The climatic conditions are such that anyone who wishes to take the trouble to do so can grow almost any kind of garden vegetable, excepting perhaps celery, peas, asparagus, and cauliflower, in his own garden at all seasons of the year.

Insect pests and plant diseases are as abundant in Hawaii as anywhere else, but in Hawaii, as elsewhere, these yield readily to the application of scientific methods of control. There are opportunities in Hawaii for farmers or market gardeners who will come here and undertake the cultivation of garden vegetables of better than average quality. Cabbages, beans, sweet and Irish potatoes, green corn, lettuce, parsley, tomatoes, beets, and onions grow as well in Hawaii as anywhere else.

Vegetables of the melon and squash family are subject to injury by a fruit fly which stings and lays its eggs in the young fruits or in the stalks, but even this pest can be successfully controlled. Excellent celery and cauliflower are grown at elevations above 2,000 feet. Sweet corn is in the Honolulu market the year round.

There are opportunties for farmers to come here and undertake the cultivation of potatoes, onions, and cabbages, very large amounts of each of these vegetables being brought to the islands every year from the mainland, or even from Australia. The success of the market gardening enterprises of this character would depend on the ability of the farmer to produce a uniform supply at all seasons of the year, and the climatic conditions are such that this is entirely practicable. The local consumer prefers island products to those which are brought in from the mainland. About $150,000 worth of vegetables are shipped into Honolulu every year, the larger proportion of which could be produced locally, and undoubtedly sometime will be, whenever the producer undertakes to supply crops of any one of these vegetables in succession throughout the year.

Many of the diseases affecting garden vegetables in colder climates attack crops grown here. All of the diseases and pests are capable of control.

VANILLA.

The vanilla bean is the cured and fermented fruit of a climbing orchid. The finished pods are very dark brown or black, glossy, somewhat wrinkled on the surface, and from 5 to 8 inches long, and about as thick as a lead pencil. The vanilla extract of commerce is simply an alcholic extract.

The vanilla plant is either grown on a trellis or is planted at the base of a tree so that it can clamber up the trunk. Any soil is suitable, provided the drainage is good. It grows well in regions of abundant rainfall on the Kona side of the islands. A mean temperature of from 65° to 75° F. gives good results.

The plants are propagated from cuttings, which are simply lengths of the vine itself, from 2 to 6 feet long. The length of the cutting has some relation to the flower production, the longer ones yielding flowers in a shorter period. The leaves are cut from the lower end of the cutting and the stripped portion of the stalk is buried horizontally under 2 or 3 inches of soil and rotting leaves. The upper end of the cutting is fastened to the trunk of the supporting tree to which it soon becomes tightly attached by its aërial roots.

The vanilla plant begins to flower during its second or third year and continues flower production until 7 or 8 years old. Cultivation consists in keeping down the weeds and underbrush in the plantation.

The vanilla plant only bears pods when the flowers are hand pollinated. This is a delicate operation not difficult to learn. Anyone who attempts it becomes quickly proficient so that a good many of the flowers can be pollinated in the course of a day. The pod matures in from six to eight months, becoming hard, thick, and greenish yellow. They are gathered before ripe.

The curing process is a somewhat complicated one. After gathering, the green pods are spread out and exposed to the air for twenty-four hours, being roughly assorted into grades according to size. After being graded, the pods are sweated between the folds of woolen blankets exposed to the heat of direct sunshine. During the period of fermentation the pods turn dark brown, become soft and leathery, and sweat freely. The pods are manipulated for several days until the proper degree of color and aroma have developed. After the fermentation they are dried in the sun for a few hours and finally in cloth-covered trays in the shade with gentle heat. When fully dried—that is, when the pods no longer lose weight, but are still moist and pliable to the touch—they are packed tightly in tin boxes and are again manipulated in bulk for one or two months. When completely cured the pods are sorted to size and color, tied in bundles, and these packages packed in tin-lined boxes, which are soldered when full.

The yield per acre in Hawaii has been estimated at about 13,000 pods, producing about 120 pounds of finished vanilla beans fully cured and ready for the market.

The industry is a very profitable one for persons having sufficient means, who will give this industry their personal supervision. The price of the vanilla bean depends as much upon the outward appearance of the finished product as upon its actual quality as indicated by aroma and flavor. Care is therefore necessary at every stage in the growth and fermentation of the crop.

Five acres of vanilla in bearing should yield from $400 to $500 worth of beans per acre per annum after the third year. There are vanilla plantations in the Kona district on the Island of Hawaii and in the Kona district of Oahu near Honolulu. Much land is still available which is entirely suitable for the cultivation of this crop.

LIVE STOCK AND POULTRY.

DAIRYING.

There are fifty dairies on the Island of Oahu and others on each of the larger islands. The climate is a good one for stock. The only serious diseases which are widely prevalent are tuberculosis and liver-fluke. No serious epidemic disease of cattle has ever been introduced into the islands. Many herds have registered animals of Jersey, Holstein, and other milch breeds.

Grasses and forage crops for soiling purposes are easily grown, but all concentrated feeds with the exception of rice polish and rice bran are imported from the mainland and are, hence, high in price. The algaroba bean, a local product similar to the mesquite bean of Texas, takes the place of concentrated feeds to some extent. Sorghum and alfalfa are the chief forage crops. Alfalfa yields, with irrigation, from ten to thirteen crops per annum. Sorghum may be cut every two months for five or six years. Other forage crops are Guinea grass, *Paspalum dilatatum,* Para grass, and Rhodes grass. Spanish clover is abundant in some districts on the islands.

Milk retails in Honolulu at from 10 to 15 cents per quart. Butter retails from 30 to 50 cents per pound. There are enough local dairies to supply milk and cream for a larger population than is now in the islands, but the importation of butter amounts to $40,000 per annum for the Honolulu markets alone. There are no special difficulties in butter making other than good water supply and care and cleanliness in handling the milk. The interisland transportation problem is one of the chief obstacles in the way of butter production on the islands, other than Oahu, for the Honolulu market.

The market for cheese is good. There are no local factories so that the field is an open one.

STOCK RAISING.

There are about one hundred ranches in Hawaii beside many individual cattle owners. A recent estimate is that there are about 170,000 head of cattle, 75,000 sheep, and 30,000 horses on the island ranches and plantations. The grazing lands of all of the islands are pretty well occupied, so that there are but few openings unless persons desiring to go into the ranching business come here provided with a sufficient capital to buy out some ranch that is already established. There is, to a certain extent, an overproduction of beef, but thousands of mutton carcasses are imported.

The stock on the island ranches is of very good quality, many breeding animals of the best beef breeds having been imported. As stated elsewhere, sisal waste is an excellent feed for fattening cattle. Cane tops are fed to stock wherever these are available.

Pig raising is a profitable industry where one has a large run or can obtain cheap feed. Live pork finds a ready market at high prices among the Chinese. Suckling pigs a month old sell for $5 each, provided they can be produced for the holiday markets—Thanksgiving, Christmas, New Year's, and Kamehameha days, the 11th of June. Both hogs and cattle may be fattened on cassava, a plant which grows almost without care. Other feeds used for fattening hogs are papayas, bananas, taro tops, and parings, and the fruit waste from the pineapple canneries. Hog cholera is prevalent, and occasionally epidemic, as it is on the mainland.

POULTRY.

Chicken raising is an extremely uncertain industry in the Territory of Hawaii, as evidenced by the high prices both of eggs and poultry, live or dressed. Fresh eggs sell in the Honolulu markets at from 30 to 60 cents per dozen, while the ruling prices for live fowls range from $12 to $18 per dozen, depending on their age, condition, and breed. For pure-bred fowls even higher prices are asked and given. This condition of scarcity is unusual in any country. It makes eggs and chickens a luxury only within the means of the well-to-do, instead of contributing to the daily bill of fare of all the people.

In the country districts the mongoose has much to do with causing this state of affairs, because of his preference for young chickens, but even in the towns, where the mongoose is seldom seen, poultry raising is and has been a precarious industry as far back as authentic records extend. This is mainly because of the great number of diseases prevalent here, as elsewhere in the tropics. Chief among these is a malady commonly known as "sore head," which decimates the flocks at the time when the chicks are being weaned by the mother hen. Roup, diarrhea, cholera, and especially colds and pneumonia, are also all too prevalent,

while lice and intestinal worms do their share toward depleting the chicken yards. Most of these diseases are due to neglect, improper care, and faulty yards and houses, and all are largely preventable.

It does not require close calculation to show that chicken raising can be made profitable in these islands if the grower will devote as much care and attention to details as in any other minor industry. The high prices for eggs and chickens and the amount consumed prove that such close care and attention to the details of the business would be profitable. During the year 1900 there were imported into Honolulu alone from the mainland about 40,000 dozens of eggs and about 75,000 pounds of dressed chickens, beside numerous lots of live fowls. The value, wholesale, for imported eggs was about $12,000 and for refrigerated chickens about the same. Thus, beside the home supply, there were imported for the use of the Island of Oahu alone fully $25,000 worth of eggs and chickens. Hawaii, Maui, Kauai, and the smaller islands are not taken into consideration in this calculation, but a good many cases of eggs find their way to Hilo and other island ports direct from the Pacific coast. The supplying of steamships and sailing vessels with fresh eggs and live poultry ought in itself to be a lucrative trade.

A brood of chickens in the dooryard, vineyard, or orchard would soon pay for their keep in the destruction of Japanese beetles and other insect pests. The waste from the kitchen and table could also be turned to more general account. Clean houses, nests, and roosts, pure water, good food, plenty of sunshine and shelter from the winds, a dust bath, some broken coral, daily care to keep the birds healthy, and instant isolation of ailing members of the flock will do a good deal to lower the price and increase the sale of fresh eggs and spring chickens in Hawaii.

The feeding problem for poultry in Hawaii is one of considerable importance because of the absence of cheap grain crops. The only cereal produced is rice, which ordinarily sells at from 3½ to 5½ cents per pound, placing it out of the question as a chicken food. Wheat, barley, oats, and corn, all imported from the mainland, sell for from $1 to $2.50 per hundred pounds, while screenings and the various mixtures known as scratch foods sell from 1 to 2 cents per pound, according to the ingredients of which they are composed. Meat scrap and green bone are proportionately high. The only cheap feeds which could be produced on a large scale for poultry feed are alfalfa, starchy root crops—such as cassava, arrowroot, and the upland taro—and the fruit of the papaya. The scarcity and high price of available poultry feeds is probably largely responsible for the high price of the product in eggs and chickens, but the prevalence of the disease among the flocks has some influence.

The most destructive disease affecting poultry is sore head or chicken

pox. A characteristic symptom is the formation of scabs on the head, feet, or other bare portions of the body of the fowls. When infection is on the head, the course of the disease is very rapid, often causing blindness and swelling or distortion of the beak, so that the bird is unable to either see its food and water or to swallow. Death from sore head in young poultry is due either to starvation, or to colds, or pneumonia. While the nature of the disease is well understood the method of infection has not been definitely determined, but the general healthiness of the flock and the care given has some influence on the severity with which the birds are attacked. Remedies are preventative (that is, to feed the flock well and see that their sleeping quarters are dry, clean, and protected from drafts) or curative (when the infection exhibits itself, by direct application of carbolated vaseline, a mixture of kerosone and lard, nitrate of silver, glycerin, permanganate of potash, iodine, ichthyol, or an alum solution).

Other serious diseases are cholera, roup, colds, pneumonia, intestinal worms, lice, and the general run of poultry diseases common to fowls in all countries.

With well-constructed, dry, clean houses, good feeding and fresh water, the poultry business can be made as profitable in Hawaii as in any other country. The high prices obtained for eggs and live or dressed fowls compensates for the high prices of the feed required, so that there is always a good margin of profit. The failures in poultry raising are due as much to the poultry owner giving over the entire care of his flock to Oriental employees as to any special difficulties not attendant upon the production of poultry in other lands.

SILK INDUSTRY.

A number of attempts have been made to establish a silk industry in Hawaii at intervals since 1837, when the first mulberry plantings were made on the Island of Kauai. The silkworm is a temperate-zone insect and althought it can be successfully reared in the warmer portions of the islands, the cultivation is only uniformly successful in the cooler zone above 2,000 feet where climatic conditions approach those of more northern countries.

The Hawaii experiment station has carried on a number of experiments with silk. The product has been pronounced by experts "well worthy of being graded as first class." The silk which the station has produced reels to better advantage than the average Japanese or Chinese product. Three pounds of dry cocoons yielded 1 pound of raw silk. The average in Japan and elsewhere is four to one. Well-dried cocoons are worth from 90 cents to $1.20 per pound f. o. b. Honolulu, while the reeled raw silk is worth from $3 to $5.

The food of the silkworm, the mulberry, thrives from sea level up to

4,000 feet. The experiment station has introduced and is propagating varieties of mulberries which are considered the best for silk production.

An even temperature is important. The worms are apparently not seriously affected by excessive humidity, provided the temperature is low, and the leaves are not wet when fed. Districts subject to high winds or severe storms should be avoided since the destruction of the foliage of the mulberry trees might occur at a critical time, thus resulting in the loss of a crop of silkworms.

The returns from silk are low, so that it is best taken up as a side line in connection with some other branch of agriculture. The care of silkworms is not an industry for women and school children, as has often been stated, but requires a man's full time during the whole period from the hatching of the worms from the eggs until transformation takes place into the cocoon. Women and children may be employeed to advantage in gathering the leaves from the mulberry trees, but the care of the worms in the silk house is one demanding considerable technical skill. Island industries which employ labor during only a portion of the year could well undertake the growing of silkworms, both because of the profit and as a means of supplying work for the laborers during the dull seasons.

The requirements for silk raising are a considerable acreage planted to mulberry trees, and a dry, well-lighted and ventilated house with large floor space. An ounce of eggs will produce enough worms to require one man's care for one month. This number of worms will consume from 2,200 to 2,400 pounds of mulberry leaves. They will occupy 60 square yards of shelf space during the last stages of development. The worms from an ounce of eggs will produce 90 pounds of fresh cocoons. These shrink on drying to about 30 pounds, worth at present quotations, as stated above, from 90 cents to $1.20 per pound. This would give a total return of from $27 to $36 as a result for one man's labor for one month, in the silk house. At the experiment station it was found that a single mulberry tree of medium size and leafage yielded 8½ pounds of green leaf at a single picking; so that it would require about 300 mulberry trees to produce leaf to care for worms from one ounce of eggs.

The above yields and prices are average ones. The mulberries are in continuous leafage in Hawaii. Mulberry trees planted for silk production are usually set in close rows or hedges; the trees are pruned closely and forced, to make them throw out young shoots. The newly hatched silkworms are fed only the youngest leaves and the older and more matured leaves are fed successively as the worms grow. The industry is one requiring considerable skill both in the handling of the worms and in the production of abundant supplies of mulberry leaves in their proper stage of development.

The production of eggs and the reeling of raw silk are operations

calling for skilled labor and an investment of capital. Under the new agriculture it is found practicable to keep silkworm eggs in cold storage for rather indefinite periods, so that crops of worms can be started in sequence at any season of the year. Egg production is a business by itself and should not be attempted by anyone who seeks to grow silk at a profit.

The profits of silk growing are as much in the reeling of the raw silk and the manufacture of cloth and piece goods as in the production of the cocoons. Silk weaving is a household industry the world over, probably 90 per cent of the Chinese and Japanese silks being woven on hand looms in the homes of the laborers who grow the silkworms. The weaving of silk is more an occupation for the employment of women and children than is the growing of the silkworms. There are a great many laborers in Hawaii who have come here from the silk-producing provinces of Japan, and these would undoubtedly take up this industry in Hawaii if they could receive the encouragement of men with capital. The market for dry cocoons and raw silk would have to be developed along with the market for silk manufactures. The field is an attractive one and it is believed that there is an opportunity for the investment of considerable capital in the development of the industry.

ADVANTAGES AND DISADVANTAGES.

The farmers of Hawaii, in common with those of all other countries, will be confronted by serious obstacles, which may be overcome. One of the most serious problems is that of controlling the many serious insects. As in all other tropical countries, insects are much in evidence. The pests in Hawaii are almost entirely forms which have been introduced from other countries. The principal insects injurious to fruits are the scale-insects, mealy bugs, and related species. The sugar planters have to contend with cane-borer, a leaf-hopper, mole crickets, and others of a more or less destructive nature. Plant-lice, cut-worms, melon flies, and various leaf-eating beetles, attack garden and field crops. Grapes, ornamental trees, and shrubs suffer from Japanese beetles and Fuller's rose beetle. However, it is well to remember that the use of direct, active measures of control will keep these pests in check in Hawaii as similar methods are used against insect pests on the mainland. It is certain that precautionary methods, the use of insecticides, and cultivation based on the habits and life-history of the insects will contribute to their control.

Other drawbacks are the high winds that are prevalent during the winter or rainy season. These often cause loss or injury to vegetables and annual crops but are not considered serious in relation to the cultivation of perennials.

As in newer countries a number of settlers living together as a community will do better than the same people in isolated locations. Whatever drawbacks there may be, those now living in the islands have faith that they are such as can be easily overcome.

The College of Agriculture and Mechanic Arts of Hawaii, an institution of the same scope and character as the agricultural and mechanical colleges of the mainland, has been established and is now in operation. The Territory maintains an efficient board of agriculture and forestry in charge of quarantine measures to regulate and prevent the introduction of serious insect pests and fungus diseases to cultivated crops, diseases of bees, and diseases of domestic animals. This board also exercises administration over the extensive forest reserves set apart in every island of the group.

The United States Department of Agriculture maintains the Hawaii agricultural experiment station, an institution of equal scope with that of any other State or Territory. There is also a representative of this Department in charge of the execution of the Pure Food Law and an observer in connection with the Weather Bureau.

The Hawaiian Sugar Planters' Association maintains, at its own expense, an experiment station devoted to the interests of the sugar industry along the lines of chemical investigation and control, manufacture and mill work, and the control of the insect pests and fungus diseases of cane. This station is one of the best equipped in all the tropical world. The results of its investigations of Hawaii's leading industry have been enormously profitable to the sugar planters.

The Farmers' Institute of Hawaii, an organization in connection with the College of Agriculture, holds quarterly meetings on the Island of Oahu. The Territory is better equipped in men, libraries, and materials for scientific research, investigation, and experiment for the benefit of agriculture than many of the older and wealthier States and Territories.

Tropical agriculture differs from that of the temperate zone in one important particular, which is that most of the tropical crops are perennials, and that most tropical products require manufacture before being salable. A farmer who grows wheat or corn or apples can sell his product immediately without any manufacturing process whatever. This is not true of tropical products. Tobacco is not salable until it has been fermented; sugar must be extracted from the cane by expensive and intricate milling processes; vanilla, coffee, sisal, and almost every other paying crop require a larger investment of capital than would be necessary for an equal acreage of any temperate-zone crop, because of the manipulation required to transform the raw material into a finished marketable article. Furthermore, the time limit adds to the necessity for larger investment, in that most tropical crops can not be harvested

in a short season. One must wait three years for vanilla, two or three years for sugar, two years for pineapples, and four or five for coffee, rubber, and sisal. Tobacco, which in its cultivation is an annual, can not be marketed in less than fifteen months because of the curing and fermentation the leaf must undergo. It is absolutely essential that the prospective settler should have sufficient resources or credit to carry himself and family through these unproductive years. Business ability is as important as knowledge of agricultural methods.

PHILIPPINE FOREIGN COMMERCE IN THE CALENDAR YEAR 1907.[1]

Commercial returns of the Philippines for the calendar year 1907, exclusive of gold and silver and Government free entries, show imports to the value of $30,453,810 and an export trade of $33,097,867. The favorable trade balance dating from 1905 is thus continued, with a credit of $2,644,057 in favor of the Islands for the year. Imports exceed by $4,050,042 those of 1906 and indicate a complete recovery from the depression of that period. In fact, import activity is the most striking feature of the year's figures, foreign purchases reaching a greater value—if the abnormal element of rice be excluded—than ever before under American occupation. Increased export values are also recorded, amounting to $454,975 more than those of the previous year, and approximate closely to the maximum established in 1905.

The increased import total for the year is very widely distributed and indicates generally improved commercial conditions. The largest and most noteworthy gains, however, are to be found in the textile and fiber trade, and the relative importance of these imports is shown by the fact that they constitute a third of all foreign purchases in 1907. The leading feature alike in this large branch of the Insular trade and in the large increase for the year is found in cotton and manufactures, which show a further expansion of practically $2,000,000 in a trade that has made uninterrupted annual gains from the depression of 1903, and which in 1907 reaches the unprecedented value of $9,000,000. In the supply of these imports the United Kingdom maintains her prestige of past years, being credited with slightly more than half, while the United States becomes a remote second with a value of $1,016,752 in consequence of largely increased sales of cotton cloths following the tariff amendment of February 26, 1906, and Spain with her strong position in the knit-goods market becomes of third-rate importance in the cotton trade as a whole. Miscellaneous vegetable-fiber imports amount to $559,076 in which is included a gain of over $200,000, while the silk trade increases from $357,061 to $505,961, and wool imports show a value of $181,834 in the generally improved textile and fiber demand of the year.

Practically another third of the Islands' import trade for 1907 is

[1] From Quarterly Summary of Commerce of the Philippine Islands, prepared in the Bureau of Insular Affairs, Washington, D. C.

embraced under the general head of foods, drinks, and food-animals. While this ten million dollar total shows some increase over the figures for the previous year, it is by no means so great as that noted in textiles, fibers, and clothing. Rice is the single item of largest value under this group, and the total of $4,166,744 for the year includes an increase of $174,831. This, however, arises from the prevalence of exceptionally high prices during the greater part of the year, and as a matter of fact the quantity imported continues the annual decline dating back to 1903, though the reduction in 1907 is relatively slight. French East Indies is even more exclusively than heretofore the source of supply.

Wheat flour is a related item that shows an increase coincident with the declining imports of rice and reaches a value of slightly over $2,000,000 in 1907. This trade was a virtual monopoly of the United States down to 1904, but American flour has rapidly lost ground since and amounts to but $391,151 for the year, while the Australasian product with the advantage of a shorter haul and a lower price has found a steadily increasing market in the Islands from a nominal value of $1,185 in 1903 to $649,704 in 1907.

In a total meat trade of $886,924 Australasia also figures prominently in consequence of a monopoly of the fresh-meat supply, and contributes half of the total for the year, while China is credited with about a quarter of a million dollars in cured meats, lard, and other meat products. In the related cattle trade, which figures largely as a fresh-meat supply, and amounts to $1,119,638 in 1907, China furnishes 90 per cent, while practically all of the quarter of a million dollar egg trade is of Chinese origin. Dairy products, amounting to $478,585, show a small increase and are made up chiefly of condensed milk from the United Kingdom and the United States, butter from Australasia, and cheese from Netherlands and the United Kingdom.

Imports of vegetables to the value of $561,116 in 1907 are practically the same as in the previous year. The three hundred thousand dollar potato and onion trade is credited to Japan, while canned vegetables to the value of $93,963 come chiefly from Spain and the United States. Total fish imports amount to $370,671 and show a notable increase in consequence of larger purchases of Spanish and American canned goods. The United States is credited with canned salmon to the value of $93,328, while Canada appears as a new factor in this distinctively American field.

Coffee and cacao, though classed as Insular products, are produced in quantities inadequate for local consumption, and are items of import to the value of $343,288 in 1907. These imports show an eighty thousand dollar increase and are chiefly from British East Indies, while a fairly constant tea trade of about $40,000 annually is of conspicuously Chinese origin.

Imports in alcoholic liquors amount to $548,602. Increased trade is to be noted in both wines and distilled spirits, but a further shrinkage of $70,000 is found in the steadily declining beer imports of several years past, for which local production is the leading cause assigned. The two hundred thousand dollar wine trade of the year is of Spanish origin. Distilled spirits to a somewhat greater value are largely of British and American origin, while the United States furnishes half of the reduced malt liquor total of $114,793.

Among miscellaneous imports constituting the remaining third of the Islands' foreign purchases in 1907 not embraced under the heads of textiles and fibers and of food stuffs and beverages, the metal trade is easily of the foremost importance. Iron and steel makes up the great bulk of values under this group and amounts to $2,296,294, with an increase of about a quarter of a million dollars over the figures for 1906. Seventy per cent of this trade for the year is credited to the United Kingdom and the United States, with a somewhat larger proportion from the former. Analysis of the figures in detail shows that the preponderance of the British trade lies in the larger and cruder forms of these metals, whereas the three-quarters of a million dollars credited to the United States is found chiefly in schedules of machinery and the more advanced forms of manufacture. Germany, with imports valued at $382,248, is the only other contributor to this trade of much importance and is credited with the largest increase of the year. In the cruder schedules, where the United Kingdom figures most prominently, Germany contributes only nominal values, but competes in the supply of higher class manufactures. Brass and copper amounting to more than a quarter of a million dollars is the most prominent remaining feature in the metal trade. Two-thirds of this total is about equally divided between the United States and the United Kingdom, while Germany is the most conspicuous minor contributor as in the case of iron and steel.

Imports of mineral oils reached the exceptionally low value of $521,896 in 1906, but this is more than compensated for in the unprecedented total of $931,494 in 1907. In this large increase the United States more than doubles the figures of the previous year and is credited with $690,142. Russian oil, formerly dominating the market, disappears entirely from the trade, and Dutch East Indies with a value of $153,241 shares but slightly in the year's increase, while British East Indies appears as a new factor in the field with a value of $75,225. The coal trade increases from $426,751 to $513,680, of which Australasia contributes $484,221 and Japanese values decline to even smaller proportions than in 1906. North Borneo coal figures to a small extent in the year's total.

Marked activity in the leather trade is a feature of the figures for 1907. Total leather imports amount to $613,561 and are larger by

$200,000 than in 1906. The greatest gain is found in boots and shoes, but larger values also appear under unmanufactured as well as miscellaneous manufactures. That the boot and shoe trade of the Islands has been largely lost to Spain is further emphasized by the year's returns, Spanish sales declining slightly in spite of the much increased total. Of total boot and shoe imports valued at $419,749, the United States is credited with $301,181 and contributes about the same proportion of the unmanufactured leather trade.

Under paper and manufactures a total value of $548,904 is found for 1907, and an increased trade of more than a hundred thousand dollars is distributed throughout the various schedules. The United States takes the foremost place as in previous years with credits amounting to $155,604, while France, Spain, Germany, and Austria-Hungary are minor contributors in the order named.

The lumber trade furnishes one of the most notable exceptions to the general import activity of the year; boards, deals, and planks showing a reduction of more than a hundred and sixty thousand dollars in value. These imports were abnormally large in 1906, but the total of $209,522 in 1907 is much smaller than that for a number of years past. Increased activity in local production has its bearing on this trade, as also does the new administrative policy of increased use of native woods in public construction. The United States is the heavy loser in these much reduced purchases, and Australasia takes the lead in the lumber trade for the year.

Opium imports show a slight recovery from the very small value of 1906 resulting from increased taxation and restrictive legislation. Of the total of $446,049 for 1907, British East Indies is credited with $390,273 and Persia with almost the whole of the balance. By act of Congress the importation of opium into the Islands is prohibited after March 1, 1908, except by the Government and for medicinal purposes. Further legislation by the Philippine Commission looking toward the ultimate suppression of the opium traffic was enacted in October, 1907, and imports during the months of November and December shrink to less than $3,000 in value.

In the larger export total for the year, showing a net increase of $454,975 over the returns of 1906, the most noteworthy and hopeful feature is to be found in the larger marketing of the various minor products of the Islands, such as maguey and other subordinate fibers, ylang-ylang and coconut oils, fish, shells, etc. In fact the four great Insular staples—hemp, sugar, copra, and tobacco—show only a nominal net gain of $13,314, though constituting 95 per cent of the total exports for the year. In sugar and tobacco substantially reduced values are to be noted. Hemp is credited with a relatively unimportant gain in the face of heavily reduced prices, while phenomenally high prices account for the considerable increase in copra values.

The hemp trade shows a substantial recovery from the reduced quantity exported in 1906 following the disastrous hurricane of September, 1905—115,395 tons being exported in 1907 as compared with 102,439 tons in 1906. The quantity is, however, still below that of preceding years, while the average price falls considerably below the compensating high figure of 1906. The average price per ton in 1906 was $191 as compared with $171 in 1907, while a very steady decline is to be noted in the monthly figures from $182 in January to $146 in December. The result of these adverse market conditions on the export trade for the year is to show but a nominal increase of $76,861 in spite of a considerably increased quantity, with indications of a somewhat less prosperous state for the great industry than in the previous year. The United States and United Kingdom are credited with 90 per cent of these exports, of which American purchases are slightly smaller in quantity, but in consequence of higher prices the value of hemp exports to the United States, amounting to $9,316,539, considerably exceeds that finding a British market.

Owing to unprecedented prices, copra ranks second in importance in the Islands' export trade and sugar drops to third place. Copra exports amount to $4,784,151, and upon a slightly reduced quantity an increase of $410,449 in value is to be noted. Export quantities show but slight change during the past three years, but the annual price per pound grows steadily from 2.6 cents to 3.7 cents and suggests the great possibilities of this Philippine product in view of the increasing foreign demand for this vegetable-oil base. In the related export item of coconut oil a value of $101,765 is recorded for the year as compared with $66,286 for 1906. While coconut oil is of general local use and domestic production, manufacture on an export scale is of very recent date, and the growth of this trade in the past two years points to the possibilities of this new export industry as a business investment, as a benefit to the Islands, and as a modifying factor in the copra export trade. Copra finds its chief market in France as in the past, with Spain and Germany as minor purchasers of leading importance, while the United States is credited with a value of $197,558—the largest during American occupation. The greater part of the oil is taken by the United Kingdom, as was the case in 1906.

Sugar exports are slightly reduced in quantity, and this combined with a lower price accounts for a reduction of $358,421 in the value of 1907. Of the total, amounting to $4,195,671, the China-Hongkong market takes the larger part as in previous years, the United States is credited with $403,851, and the United Kingdom and Japan with smaller sums.

In the tobacco trade exports show a decline of $115,575 and amount to $2,727,429. In the manufactured schedules increases are found, but these are more than offset by a reduction in the abnormally heavy leaf

exports of 1906. Spain and Austria-Hungary continue to be the largest leaf purchasers of the million and a half dollar total, while the million dollar cigar trade, though credited to forty-one different countries, is appropriated to more than 75 per cent by Hongkong, British East Indies, Australasia, China, and the United Kingdom. The United States is credited with no purchases of leaf tobacco during the year, but with cigars to the value of $24,200.

Exports of maguey fiber show increases both in quantity and price in 1907 and amount to $297,158. American purchases amount to $198,233 and for the first time the United States becomes the leading market for this product. In view of the general interest in its cultivation manifested throughout the Archipelago, the active measures taken by the Insular Bureau of Agriculture for the introduction of improved varieties, and the steady improvement in the price of these exports, it seems probable that this type of fiber may become another important fiber asset of the Philippines, and that the Islands may come to share in the prosperity it has already brought to Yucatan through the supply of the heavy demands of the American market.

In the trade of the United States with the Philippines in 1907, imports of American goods show an increase of $589,652 over the reduced value of 1906 and amount to $5,067,538, though they are still more than half a million dollars less than in the banner year 1905. Of the above total more than 60 per cent is found in the cotton and the iron and steel trade, and in the items of mineral oils, wheat flour, and boots and shoes. The most conspicuous gains for the year appear in imports of cotton goods, mineral oils, and boots and shoes; the heaviest loss is in the lumber trade, while agricultural implements and wheat flour suffer to a less extent. Exports to the United States in 1907 are less by about a million and a half dollars than in the previous year, in consequence of larger British participation in the hemp trade. Purchases of Philippine sugar suffer but a slight decline, while maguey and copra find a substantially American market.

THE DISTRICT OF DAVAO.

By Max L. McCullough,
Secretary, Davao Planters' Association.

The district of Davao, situated in the southeastern part of Mindanao, is the largest of the five districts comprising the Moro Province. Here, more than in any other part of the Philippine Archipelago, are to be seen the results of American interest in tropical agriculture. The justice of American government, impartially administered, together with the optimism and activity of the early colonists in this region, have been the principal causes of the present prosperity, while the spirit of American enterprise and industry and the intelligent application of modern methods to the problems of tropical agriculture afford the strongest hopes of future progress and wealth.

STEPS IN DEVELOPMENT.

When the sturdy pioneers of western America were pushing across the desert to the gold fields of California, the first steps were being taken toward the establishment of Spanish sovereignty in Davao. In 1848 the first blow was struck by the Christian subjects of His Catholic Majesty against the power of the Moros who, though much inferior in numbers to the pagan tribesmen of the district, completely dominated them.

From this time during the half century that followed until American occupation in 1899 the district grew in population, trade, and commercial importance, and since then progress has been more rapid and substantial than under Spanish rule. To-day more than forty American companies are developing plantations in the district and some 4,000,000 "hills" of hemp have been planted. Two hundred tons of fiber from the older plantations are exported monthly, while a growing interest is being shown in such products as rubber and coconuts.

The first American troops, which arrived at Davao in 1899, were volunteers under the command of Capt. J. L. Burchfield and others. Captain Burchfield subsequently returned to Davao after being mustered out of the service and was the first American to open up a hemp plantation in that district.

The volunteers were followed by troops of the Regular Army, one of

the officers, Lieut. E. C. Bolton, Seventeenth Infantry, becoming the first civil governor of Davao. The life and work of this energetic, capable, and conscientious young officer in the formative period of the district's government will ever be one of the brightest pages in the history of Davao. By almost constant "hiking" over the trails of the gulf region, and through his sympathetic interest in the affairs of the natives, he gradually brought an enduring peace out of the political chaos of fourteen warring tribes, ignorant alike of the intentions of the Americans and the fundamental principles of western civilization. He thus made possible for them a more settled form of life and induced them, by his own personal endeavor, to take up the planting of hemp for a livlihood. At the same time the opportunities in the district for the white man were becoming better known and every possible effort was made by the governor to induce Americans to visit and settle in the country.

Early in 1904 a report on southeastern Mindanao was made by the fiber expert of the Bureau of Agriculture, which proved of considerable interest. This report was published in the Official Gazette and had the effect of bringing the district of Davao to the attention of the Americans in the Philippines. General Leonard Wood, then governor of the Moro Province, also did much to attract attention to the rich resources of the Davao country. Before the year was out several companies had placed representatives in the district and the work of transforming the wild jungles into productive farms had begun. To-day, as has been said, forty American plantations are in active operation, while new and larger companies are expected to commence work in the near future.

SIZE AND OPPORTUNITY.

There is a great abundance of very fertile land available for development. The district of Davao is about 140 miles long and 120 miles wide and contains more than 5,000,000 acres of Government land. Only the most accessible land has yet been taken up by settlers, although the very best hemp land is generally found away from the beach nearer the foothills or along the fertile river valleys a few miles inland. Better transportation on the gulf has recently brought outlying lands into closer touch with the markets and has thus made available for plantation purposes land formerly undesirable on account of its distance from the centers of trade and inadequate transportation facilities.

POLITICAL CONDITIONS.

Although the first district governor met his death by treachery at the hands of native chiefs, owing to envy and jealousy among them, the former peaceful condition of the district has suffered no change. The policy of the Government in encouraging American enterprise in the district has been continued with even greater zeal by the second district governor, Lieut. Allen Walker, Philippine Scouts.

For a considerable time after the establishment of American authority in the Philippines there seemed to be a feeling among those responsible for our laws that it was not desirable at that time to encourage American capital to invest in the Islands.

Among the settled Christian provinces of the northern islands there was probably considerable opposition on the part of native leaders to what may have seemed attempts to exploit the natural resources for foreign interests at a time when the Filipino people, owing to war, etc., were not able to avail themselves of their rightful share in the development of the country.

However, while this may have been true of the northern provinces, it was never true of Davao or the Moro Province generally. In Davao only 12 per cent of the population are Christian Filipinos, the majority of the inhabitants belonging to pagan and Moro tribes who exert no influence in political matters whatever. A very small part of the land in the district is claimed by private ownership, so that the taking up of Government land by Americans has brought forth no adverse comment from the Filipino, who, on the contrary, has seen his own holdings increase in value by the opening up of contiguous territory. This phase of the political situation, combined with the liberal administration of the government of the Moro Province, and the fact that in Davao there is found only a small percentage of the troublesome Moro element, have appealed most strongly to prospective investors.

The government of the Moro Province is administered by a governor, who is a general in the United States Army, assisted by a legislative council composed of a secretary-engineer (also an Army officer), a treasurer, and an attorney. This council enacts laws designed to fit the peculiar conditions found throughout the Moro Province, which are quite different from those existing in the northern provinces, owing to the small percentage of Christian Filipinos in the population, and of necessity require special legislation. All laws enacted for the Moro Province are subject to the approval of the Philippine Commission.

The Moro proper, with his Mohammedan religion, has presented the most difficult problems in government. In many parts of the province he is still a disturbing factor, but in the district of Davao his influence is practically nil, owing to the fact that he forms only 7 per cent of the population and lives in scattered communities separated from one another by peacefully inclined tribesmen.

For this reason, the fanatical opposition to innovations in government, social customs, and methods of agriculture found in other districts, is fortunately absent in Davao. The enlightened and progressive government at the capital of the province, and the absence among the natives of serious opposition to proposed measures of reform, have had great influence in causing prospective investors to decide in favor of the district of Davao as the field of their activities. This has given the

district a community permeated by the spirit of American initiative and enterprise, while an impartial government maintains law and order and insures respect for the rights of the inferior races.

PLANTATION LIFE AND PROGRESS.

A description of Davao's geographical position, her forest-covered hills and fertile valleys, her climate and her picturesque population may be found in greater or less detail in published official reports on the district. One of the most distinctive features of the history of this distant agricultural colony is the work of the Davao Planters' Association. Organized in the early part of 1905, it embraced practically all the Spanish and Americn planters of the district.

New arrivals have associated themselves with the organization and have, in turn, added to its prestige and usefulness. Its purpose is the securing of unity of effort among the planters and the promotion of planting interests, both individual and collective, within the district. The governor of the Moro Province, in his annual report for the fiscal year ending June 30, 1907, speaking of the great progress made in the Davao district, says of this organization:

> Direction in all this work has been given by the members of the Planters' Association, a body of men who have rendered inestimable service in the development of the district and whose energy and intelligence have stimulated the progress of the entire province.

The work done by these colonists on this, America's farthest frontier, has been arduous in the extreme. The process of making a well-ordered plantation from a tropical jungle requires hard work and a spirit of perseverance that frequently taxes the powers and the patience of the plantation manager to the utmost.

The labor situation in the district presents problems all its own and for a time it seemed that the work of development would be seriously hampered by the lack of this essential factor. But by the use of methods demanded by local conditions, where three-fourths of the inhabitants are wild, pagan, half-savage hill tribes, and by the importation of Filipino labor from the Visayan Islands, the labor situation has so greatly improved as to no longer present serious cause for anxiety.

Heretofore a large supply of labor has been absolutely essential to planting operations in Davao, owing to the primitive methods used. The unanimous advice of all Spanish and native planters to the Americans first undertaking hemp planting, was to select only forest land and leave ground covered with "cogon" or other grasses severely alone. This advice proved good so long as hoes and bolos were the only implements available for the work of cultivation. It was found easier to cut down and burn a heavy forest and set out hemp plants among the charred stumps, than to remove the weeds and noxious grasses of the open land

PLATE I.

This tree, growing on plantation of the Davao Trading and Development Company, is 2 years old, 15 feet high, and 17 inches in circumference at the base.

with hand tools. When once the clearing had been made and "camotes" set out to cover the ground and keep down weeds, the further care of the growing hemp was easy. While, on the other hand, the pernicious grasses of the open country gave to the "man with the hoe" never-ending trouble, and to the plantation manager constant expense.

But those who in their own land had seen the benefits of labor-saving machinery were not to be long satisfied with this crude and costly method of developing a plantation. If machinery was so essential to farming at home, why not employ it in planting hemp in Davao? Accordingly, one of the planters, upon reorganizing his company for work on a larger scale, embarked from New York with a complete line of agricultural implements, including plows, harrows, weeders, and farm wagons, with which he has successfully broken up and planted a field of the dreaded cogon grass. Some 90,000 hemp plants have been set out and cared for during the past year, at a surprisingly small expense (aside from the original cost of the equipment). The grass has been killed, hog-proof fencing put up, and the young hemp plants set out in rows where no logs or stumps obstruct the view or mar the appearance of the plantation, while the improved condition of the hemp itself shows the great benefits of proper cultivation.

This kind of ground has been used for many years in sugar-raising on the Island of Negros, but is as yet a novelty in hemp-growing. The success which has rewarded modern methods on the plantation mentioned above and at other places where a small amount of plowing has been done, has opened up new possibilities in Davao, not only in the matter of hemp, but in the planting of rubber, cacao, coconuts, and other crops as well. In some localities irrigation has been found necessary, and where this is the case a plowed field presents few of the difficulties encountered in running ditches through ground covered with logs and fairly bristling with stumps and snags.

YIELD AND PROFITS.

Few of the American plantations in Davao have reached a self-supporting stage. Many of them are still too young to be producing fiber and the older ones which now have mature hemp are constantly incurring additional expense by increasing the annual plantings. It is difficult to give definite figures on the average yield of hemp in the district, as not many managers keep exact statistics and comparatively few of the American plantations are as yet producing. On this point the report of the provincial governor gives the following:

> The returns of the Planters' Association for the last six months would indicate, with two strippings a year, an annual average of 18 piculs per thousand hills of hemp. There is a case of one field—some 3 or 4 acres—on the banks of the Taloma River, which for the last four years has produced annually between 30 and 40 piculs per thousand. The same figures have been given for a small amount of hemp on the Matina River and in favored locations in Darong.

The average price for hemp in Davao during the last two years has been about ₱20 per picul. One small American plantation at Santa Cruz is now producing 40 piculs of fiber per hectare (1,000 hills). Some 9,000 hemp plants on this place, costing for planting and cultivation (aside from the labor of the manager, who gave it his special care) ₱1,100, produced by the time it was thirty months old ₱4,000 worth of fiber. In this time, two and one-half years, hemp does not reach its full maturity, so that the indications point to even a greater yield during the next six or eight years. These figures are given to show what can be done in Davao with hemp, when soil, high cultivation, irrigation, and wise and careful management are combined to favor the enterprise. Under such conditions, hemp is one of the most remunerative of tropical products.

CONCLUSION.

The secretary of the Davao Planters' Association will at any time be glad to answer inquiries and give more detailed information to prospective settlers or those interested in the district.

The prevailing spirit among the pioneers who have cast their lot with the fortunes of Davao has been one of optimism and enthusiasm. The development of this district has in reality just begun. What is now needed is larger capital to adequately develop the resources of the district.

Davao district offers to the newcomer a just and stable government, conditions of peace and order, unoccupied Government land rich with the accumulated fertility of the ages, fair transportation facilities, American neighbors (the benefit of whose experience in plantation work may be had for the asking), a climate free from many of the annoyances found in other parts of the Philippines, a section in which cholera, surra, and rinderpest have never made their appearance, and a community whose intelligent coöperation will tend to perpetuate existing favorable conditions, thus insuring a high quality of product and a good market price.

PLATE II.

Cocoanut tree $4\frac{1}{2}$ years old; nuts (second crop) nearly mature.

IRRIGATION PROBLEMS.[1]

The Philippine Government has appropriated ₱750,000 for the purpose of installing irrigation systems in the Archipelago which, with ₱250,000 made available last year, gives ₱1,000,000 for this work which will be promptly prosecuted. This action was taken in view of the danger from drought which last year had a serious effect on the rice crop. This action of the Philippine Government has been the result of special study of the success with which the British have installed irrigation systems in the Far East and with the advantage that the Philippine Government will have the benefit of British experience. With rich soil, an agreeable climate, and a reliable supply of water for irrigation, the farmer is in the position of one who may expect with the greatest degree of confidence that Providence will do the rest. The farmer who depends on the irregular rainfall is one who has failed to appreciate the old saw, "Providence helps those who help themselves." This has been the result of constant effort on the part of the Hon. W. Cameron Forbes, Secretary of Commerce and Police.

Experience has taught some bitter lessons, but it can not be said that the government of India has not profited thereby. There has already been inaugurated a gigantic system that might be said to be the mere nucleus of the complete scheme proposed in that colony.

Irrigation in Australia has been discussed for years and there is a prospect that in the successful exploitation of the idea, an era of the greatest development the world has ever known will be inaugurated. In this connection, Capital, the leading financial paper of India, under the caption "Colonial irrigation," says:

Where irrigation plays such a prominent part as is the case in India, it is of interest to learn what is being done in this direction in other portions of the Empire. It was thought, a few years ago, by pastoralists, and others in the Australian colonies, that though artificial watering of the soil might be profitable in a country like India, where labor is cheap and abundant, it would be waste of time and money to attempt it in Australasia, with its sparse population and expensive labor. This notion has been totally dispelled by the experiences of the past few years, and irrigation on a considerable scale is taking place in all the Australian States by means of artesian wells, and water is found in large areas over many hundred thousand square miles in Queensland, New South Wales, South Australia, and Western Australia. The supply comes both from the rainfall itself and from the various rivers which soak through

[1] Published in the Far Eastern Review, vol. 5, No. 1.

their channel beds into a soft absorbent rock which is tapped by boring to varying depths, even as great as close upon 3,000 feet. The results are in some cases truly marvellous, one government bore in New South Wales giving out over 800,000 gallons of excellent water per day. Curiously, Victoria is the only one of the colonies where this artesian water appears to be in small supply, it being thought that there is a wall of impervious rock on the border of New South Wales which diverts the underground current. From some of these bores the pressure is immense, and the water is thrown to a great height, whereas in others it only just overflows the bore hole, the difference, no doubt, of course, depending upon the relative elevations of the place of intake and that of outflow.

Irrigation, therefore, may now be regarded as having passed the experimental stage, and, whilst there is argument for the saving of the necessary plant required, and growing crops by the more natural means which, generally speaking, are fairly successful in every two out of three years, it is of much interest to compare the net result on nonirrigated land of similar character and under similar climatic conditions, with the experience of one of the pioneer irrigators.

The yield per acre on the unirrigated land was as follows:

Wheat, 10½ bushels; on the irrigated, 20 to 45 bushels.

Hay, 1 ton 2 cwt.; on the irrigated, 2 to 4 tons.

Barley, 10 bushels; on the irrigated, 30 to 52 bushels.

Potatoes, 2 tons; on the irrigated, 9 tons.

On the government experimental farms, as well as on private properties, all sorts of fruit, grain, lucerne, root crops, and products of every kind, have been grown with success. Hay yields enormously as above shown, sorghum grows to a height of 8 feet in ten weeks, and fruit grows to perfection. In one district experience showed that 15,000 sheep can be fed upon 250 acres of irrigated land for three months.

The government has also various schemes on hand for the conservation of water, one being a high masonry dam across the Murrumbidgee River, designed to hold a depth of 200 feet of water and having a capacity of 766,000 acre-feet of water.

Another scheme is a moveable diversion weir, on the same river, to turn the water from the river into a main canal; with various distributing channels to convey the water on to numerous small holdings. The irrigation rate proposed for land on this canal works out to the moderate annual rate of 10 shillings to 12 shillings per acre for a full supply of 24 to 30 acre-inches.

The furrow system is that almost generally adopted, where practicable, being economical and causing less evaporation, as well as having the advantage of an equal distribution over and soaking of the soil, and being available for cultivation as soon as the furrows become dry. After cultivation, land which has been irrigated retains the moisture, as the loose soil on the top prevents much of the evaporation, and therefore crops so watered and worked will require less frequent waterings than where cultivation is not carried out.

It has often been discussed as to whether, if irrigation were to proceed on a very extensive scale in the Australian colonies, there would be a sufficiency and constant supply of water, and as far as is at present known it may be answered affirmatively, the supply apparently being inexhaustible.

Up to now the results have been eminently satisfactory and the tendency is for the irrigable portions of the various States of the Commonwealth to steadily attract population.

PLATE III.

SUGAR-CANE NOTES.

SUGAR-CANE SMUT.

(*Ostilago sacchari.*)

By C. B. ROBINSON, *Bureau of Science.*

FIRST REPORT.

MANILA, *April 6, 1908.*

On April 1, Mr. Mariano Perlas, No. 445 Calle Paz, Santa Cruz, Manila, brought to the laboratory of the Bureau of Science a number of young shoots of the sugar cane badly affected by a disease resembling smut, which had been sent him by his brother, at Santa Rosa, in the Province of La Laguna. From the apex of the cane a prolongation had grown and not only was this covered with the spores of the smut, but they formed a solid core to the plant extending down through its interior to 3 or 4 inches above the ground. All the plants brought in were young, but whether this was merely a matter of convenience or whether only young plants had so far shown the disease he was unable to say, and he did not know how extensively the disease had shown itself, but believed it was only at Santa Rosa. The shoots were of the yellow variety of sugar cane, and he believed that the red variety was not affected.

Only one smut has ever been recorded as parasitic upon the sugar cane, *Ustilago sacchari* Rabenh, only known from Italy and Natal until the last decade, during which it has appeared in Java and in India, and received some attention from various mycologists. Except in one case, only abstracts of their work have been seen by me, but the general conclusions seem to be that it is not a very dangerous disease, that it is chiefly transmitted by planting cuttings from infected plants, and that it only infests certain varieties of canes. As regards treatment, no specific method has been found suggested, only the obvious ones of burning all infected material; and what should therefore be superfluous, that no shoots from infected plants should be used for planting; finally that selections should be made from such varieties as have proven most resistant.

It is not, however, certain that this is the exact disease with which we have to deal. The spores have already been germinated upon glucose agar, and leave no doubt that the parasite is really an *Ustilago*. But the spore's coat is not sufficiently smooth for *U. sacchari* as described,

the terminal prolongation of the diseased plant, while similar in nature, is not so long, and the area bearing spores is very much greater. To ascertain whether or not the species are the same, material has been sent for comparison to India and Java, where *U. sacchari* has been studied, also to mycologists in Ceylon, England, and Germany.

Where artificial inoculation experiments with *U. sacchari* have been performed elsewhere, the spores have required nearly a year to germinate, so that if the present disease is showing itself only or chiefly in young plants, the probability is considerable that its spread is due to the planting of canes which have already contracted the disease. Even if it were not due to *U. sacchari,* the probability is that its life-history is similar, though that is a matter requiring investigation.

SECOND REPORT.

MANILA, *April 18, 1908.*

I left Manila on the morning of the 13th instant for the purpose of further investigating the smut disease of sugar cane reported from the Province of La Laguna. Mr. Harold Cuzner, of the Bureau of Agriculture, accompanied me.

We reached Santa Rosa about noon, and after calling at the presidencia, went to the house of Señor Pedro Perlas, from whom the infected plants had come, and thence to his fields lying in different places within the town of Santa Rosa, the most important being near his mill about 2 miles from the pueblo in the direction of Pulung, Santa Cruz. The disease had not been noticed except in one field a quarter of a mile from the mill, where a very large proportion of the plants are infected, but, in one corner, to which spores would not be borne by what was, at least at the time of our visit, the prevailing wind, all the plants were apparently exempt. The disease is confined to the yellow variety of cane, and so far to the "retono" crop; that is, where new plants are being grown from roots from which canes had been cut in the previous season.

All the plants in this particular field have that origin. Elsewhere many are being grown from cuttings, and not a single case of the disease has so far appeared among any of them; but they seem to me too young to be likely to show external evidence of it; another month, probably less, should be sufficient. Señor Perlas is making every effort to grow the red variety of cane to the exclusion of the yellow; but has not sufficient stock as yet to confine himself to it. He seems to appreciate the nature of the case, and will likely devote the field which is the source of the danger to another kind of crop till the trouble appears past. Under his guidance we visited all his fields, some of them several miles from the one in question, but could find no further case of the infection.

On the next morning we drove through the sugar-growing district, stopping at the presidencias at Cabuyao and Calamba, inspecting, as we

went, the fields along the road. All looked so healthy that we only actually walked through one. So far as this disease is concerned, no trace of trouble could be found; Mr. Cuzner, however, found plants affected by a borer, and upon closer inspection they proved to form a measurable fraction of the whole, perhaps one-tenth. The people at the adjacent mill said that these borers appeared intermittently; some years they are numerous, in others there are none. Our inquiries regarding the smut brought no additional information and both presidents promised to investigate further, and inform us if they learned anything.

Apparently that disease in the district infected is confined to the one field, has certainly not been noticed until very recently, and probably therefore has not been there in any previous recent year unless in very slight quantity, and it must almost certainly have been in evidence sooner had it been other than of very recent origin. If the plants now being grown from cuttings were somewhat further advanced it would be possible to speak quite positively. If they are free from disease, it will indicate that the plants from which they were taken were then healthy, and we already know that it was at least not noticed upon them. The plants now affected were presumably healthy when these cuttings were made, and must have become infected in the meantime from spores in the ground or blown through the air, and as the evidence, though necessarily negative, indicates that the source of the spores can not be in the immediate vicinity, the disease must also be looked for elsewhere, especially to the northeast and southwest.

If the plants growing from cuttings also prove diseased, this explanation might still be true; it would be more probable, however, that they were already infected when planted, and the disease was therefore present in previous seasons, even if unnoticed.

The Bureau of Agriculture has sent circulars to many of its correspondents throughout the Islands describing this smut and its methods of appearance, and requesting information if it has appeared. Should this have no result it may be advisable to investigate in Batangas Province in some parts of which this crop is extensively cultivated.

At Santa Rosa we were told that no plants have been introduced from outside the district for some time; the last however, were from India, a country in which the cane has been attacked by a smut for some years. When seen in the field, the Santa Rosa plants showed characteristics not evident in the dried material brought in, and little doubt remains that our problem is the one that has already been studied in both Java and India.

Sugar is not planted in La Laguna to nearly the same extent as in pre-insurrection days, but the area under cultivation is now very rapidly increasing. We saw none on the way from Calamba to Los Baños, and returned from the latter place to Manila next morning.

THE SUGAR-CANE BEETLE.

(*Heteronychus pauper* Burn.)

By W. Schultze, *Bureau of Science.*

This species is closely related to the *Oryctes rhynoceros* Linn., or coconut beetle ("uang"), the larvæ of which are found quite frequently in decaying vegetable matter or even in horse manure. The favorite breeding place for the sugar-cane beetle is in old sugar-cane fields; that is, fields from which a second crop of cane is grown, as a great deal of old vegetable matter and rubbish is generally found in such places.

The female of *H. pauper* deposits its eggs on the old pieces of cane left in the ground and the young larvæ in feeding burrow downward. If the supply of food is exhausted they attack other cane in the neighborhood.

As a remedy I would make the following recommendations: The adult beetles are easily attracted by light. For that reason a lamp or lantern should be placed in a suitable basin containing water on an elevated place, at about the same height as the sugar cane and near or on the infected field. In this manner the adult beetles are easily trapped.

When a crop has been cut, if the planter wishes to grow new cane from the old roots he should first be sure that they are in good condition. The best way to do this is to pull some of them up in every part of the field, in order to find out if the insects (beetles or grubs) have attacked them. If more than a very few show signs of the insects, it is much better to pull up all of the roots and plant new, strong seed cane.

Some kinds of sugar cane are less likely than others to be injured by this beetle, but we do not yet know which are the best. It will be of great value if sugar-cane planters will make observations in this line and inform this Bureau about the matter.

It is advisable to take away or destroy, by burning, all the old leaves and other rubbish in and around the fields, as the insects are very likely to be attracted by anything of the kind.

HAWAII'S GREAT SUGAR INDUSTRY.[1]

Fifty years ago Hawaii produced enough sugar for home consumption and exported less than 100 tons; to-day one sugar mill alone has an output of 200 tons per day, and during the year 1906 the exports of sugar from Hawaii reached the enormous sum of $24,000,000. Fifty years ago the mills consisted of small wooden rollers, fed one stick at a time by hand and operated by oxen, and the yield by this process was less than 50 per cent of the sugar really in the cane. At present the juice is extraced by rollers weighing 16½ tons apiece, to which hydraulic pressure of 430 tons is added, with the result that the best mills press

[1] From Leslie's Weekly.

out from 90 to 95 per cent of the sugar and leave the cane as dry as a shaving. In the early days the average yield was less than a ton of sugar to the acre, while to-day it averages at least 4 tons to the same area. Less than half a century ago sugar brought 10 cents per pound, and even then the planters lost money; to-day they receive from 3¼ to 3½ cents, and many of them are millionaries.

While this experimenting has been going on, the plantations have had their "ups and downs"—one year paying handsome dividends, and small ones the next, and vice versa. The first real impetus to the trade there came during the civil war, which cut off the sugar supply of the Southern States and raised its price, and again in 1875 the reciprocity treaty between the United States and the Kingdom of Hawaii caused increased activity in the raising of cane.

Irrigation has played no small part of this marvelous growth.

CUBAN SUGAR CROP.[1]

During the past few months various estimates have been made as to the extent of the present season's sugar crop in Cuba, but all have more or less agreed that there would be a shortage as compared with last year. According to most recent reports, those best qualified to judge would now definitely place the crop below 1,000,000 tons.

The United States consul-general at Havana, writing under date of March 13, states:

> The great majority of planters and others interested assert that 950,000 tons will represent the maximum, and 850,000 tons the minimum crop. There is a good reason for believing that 900,000 tons is not too low an estimate, for it is known that cane cutting has practically ceased in many districts and that some of the mills will stop working on April 1, or thereabouts.
>
> Under the most favorable conditions the grinding season will be finished by the end of April. The latest returns available dealing with the shipments and stock on hand for 1908 up to March 1, show a falling off of nearly 40 per cent, as compared with figures for the same period of 1907. If this shortage is maintained to the end of the season the volume of the crop will be below 900,000 tons.

Discussing the same subject, the New York Journal of Commerce says:

> The United States ordinarily depend upon Cuba for about half their consumption, but this year, the crop, on account of drought and other causes, will, as far as can be estimated, be from 400,000 to 500,000 tons short. The output last year was 1,427,000 tons, and conservative estimates for 1908 have been lowered from 900,000 to 1,000,000 tons. To make matters worse, Porto Rico, San Domingo, and the British West Indies all show reduced yields, so that there is a total shortage of 500,000 to 600,000 tons. A significant indication of the situation is the fact that owing to unfavorable conditions thirty-three central factories have ceased grinding in Cuba.

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[1] From the Agricultural News, West Indies, May 2, 1908.

SUGAR CONSUMPTION IN THE UNITED STATES.[1]

Messrs. Willett & Gray have published a report on the sugar trade of the United States for the year 1907.

From the statistical tables given it is seen that the total consumption of sugar during the year was 2,293,979 tons an increase of 129,966 tons, or 4.538 per cent, as compared with the amount consumed in 1906. The increase compared with the consumption of 1905 is 231,797 tons, or 8.6 per cent.

Full duty was paid on 355,297 tons of sugar consumed, while the amount of sugar on which a concession of duty was allowed, was 1,351,000. The consumption of duty-free sugar (from Hawaii and Porto Rico) was 1,287,582 tons.

Cuba contributed 1,340,400 tons; the Hawaiian Islands, 418,102 tons; Porto Rico, 212,852 tons; the Philippine Islands, 10,700 tons. The amount of home-grown sugar cane consumed was 264,968 tons, and of home-grown beet sugar 375,410 tons. The consumption of maple sugar amounted to 10,000 tons.

The total amount of refined sugar consumed during the year was 2,843,928 tons. Of this no less than 2,841,246 tons (or 99.9 per cent) was refined in the States.

The average consumption of sugar per head of United States population during 1907 was 77.54 pounds, compared with 76.1 pounds in 1906, and 70.5 pounds in 1903.

Since 1897 the full duty on sugar imported into the United States has been 1.685 cents per pound, 96° test. As already mentioned, sugar from Hawaii and Porto Rico pays no duty, while that imported from the Philippines is allowed a reduction of 25 per cent, and from Cuba, 20 per cent. Sugar from all other countries pays full duty.

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[1] From the Agricultural News, West Indies, May 2, 1908.

AGRICULTURAL CONDITIONS IN TARLAC PROVINCE.[1]

By PABLO TECSON,
Superintendent of Agricultural Extension Work.

MANILA, *June 16, 1908.*

SIR: I have the honor to submit the following report regarding agricultural conditions in the Province of Tarlac, with special reference to the municipalities of Tarlac, Victoria, Gerona, Pura, Paniqui, Camiling, Moncada, Capas, Concepción, and Bamban, through which, in accordance with your verbal instructions, I recently made a trip of inspection.

Tarlac is largely an agricultural province, the principal products being rice, sugar, and corn. There are also many small coconut plantations, but at the present time the trees are injured by the ravages of beetles. The soil is well adapted to coconuts, and this industry would undoubtedly become more general if this pest could be exterminated. Ylang-ylang is cultivated to some extent, especially in the municipality of Tarlac, and maguey in the municipality of Paniqui.

The amount of rice harvested last December and January was small, the shortage being estimated at about 50 per cent. Both drought and excessive rains were responsible for this decrease, as there was no rain during certain periods and excessive rains during the months of July and August.

Corn and sugar cane are doing well at the present time, and a satisfactory yield of both these crops is expected.

There is very little disease among live stock. A few cases of rinderpest have been reported from Concepción, and foot-and-mouth disease from Victoria.

There are large areas of uncultivated land in this province. This fact is due principally to the lack of draft animals, and also to the construction of a dam in the Albendia River at the town of Tarlac. This dam, while a benefit to the municipality of Tarlac, yet injures the municipalities of Paniqui and Moncada to such an extent that a large part of the lands therein are now idle.

In order to avert the possible famine which might follow another

[1] Extract from report made to the Director of Agriculture.

drought this year, provincial and municipal committees have been organized for the purpose of improving agricultural conditions in this province by encouraging the planting of vegetables, tubers, and fruit trees, and gratuitously assisting in the construction of irrigation canals.

So much for the general conditions in the Province of Tarlac. As the agricultural situation and the needs of the people differ in the various municipalities, I will now consider these municipalities separately.

TARLAC.

This municipality, which is the capital of the province, produces rice, sugar, and corn. Rice is harvested twice a year, in December and May. The December crop, owing to drought, was about 30 per cent less than that of last year. The May crop suffered a loss of about 15 per cent on account of excessive rains. Sugar cane and corn promise an abundant yield. The cultivation of ylang-ylang receives considerable attention in this municipality.

This municipality has several irrigation canals, and because of this fact the shortage of last year's rice crop was less than it otherwise would have been.

No disease is reported among draft animals.

VICTORIA.

Rice is the most important crop of this municipality. Victoria was one of the greatest sufferers during the recent drought, the shortage of the rice crop being about 75 per cent. The small patches of corn and sugar cane are doing well, but coconut trees are injured by the ravages of the beetle referred to above.

There is only one irrigation canal in this municipality, the water being obtained from the Tarlac River. This is a private canal, however, and is used exclusively by its owner. The people offer to work without compensation in the construction of dams and irrigation canals, in order that they may use the waters of the Tarlac and San Juan Rivers, and only ask that they may have an engineer to direct them.

Foot-and-mouth disease exists to some extent in this municipality.

GERONA.

Rice, sugar, and corn are the principal crops. The shortage in the rice crop is estimated to be about 60 per cent. The rice crop is an uncertain one in this municipality as the river is not large enough to supply sufficient water throughout the year. During the dry season, in March, April, and May of this year, that part of the Tarlac River in this municipality dried up, as did the shallow wells located in the higher places in the town.

No animal diseases are reported.

PURA.

This municipality is in about the same condition as Gerona with respect to water supply. It has no river furnishing water for irrigation, and hence the yield of its principal products, which are rice, sugar cane, and corn, is a matter of uncertainty. The shortage of the rice crop this year is estimated to be 66 per cent. Corn and sugar cane are in good condition at the present time.

No animal diseases are reported.

PANIQUI.

As previously stated, this municipality has suffered by reason of the construction of a dam in the Albendia River at the town of Tarlac. Large tracts of land, which should be cultivated, are now lying idle because of the fact that they are completely inundated during the rainy season, the water remaining on the land for lack of the outlet previously afforded by the Albendia River.

The principal crops are rice, sugar cane, and corn. Judging from the favorable appearance of the growing crops at the present time, good yields may be expected. The last rice crop suffered as much from excessive rains during July and August as from drought in October and November. The shortage of this crop is estimated at about 60 per cent.

The most important work that can be done to improve agricultural conditions in this municipality is the construction of canals for irrigation and drainage.

CAMILING.

Under normal conditions, the amount of rice produced in this municipality is estimated at 100,000 "uyones," or 300,000 cavans of hulled rice. The present crop will suffer a loss of 40 per cent as a result of the long drought.

Camiling is fairly well supplied with water for irrigation purposes, including a large river and several canals, and it is owing to this fact that the loss from drought has not been larger.

The inhabitants of this town with whom I talked expressed an earnest desire to have an engineer sent there for the purpose of improving the systems of irrigation now existing in the municipality, and constructing such additional canals as may be necessary to afford an adequate supply of water throughout the year. They offer to do the work without compensation.

MONCADA.

The soil of this municipality is adapted to rice, sugar cane, and corn. The ordinary production of rice is about 60,000 "uyones," or 180,000 cavans of hulled rice. By reason of the drought the last crop suffered a shortage of about 70 per cent as compared with the normal yield.

This municipality, like Paniqui, has suffered by the construction of the dam in Tarlac and the closing of the Tarlac River. It has large

tracts of land that are now uncultivated owing to the danger of their being flooded during the rainy season.

The most important measure that could be taken for the improvement of agricultural conditions in this municipality is the construction of drainage canals.

CAPAS.

The same general conditions prevail here as in the other municipalities mentioned. The principal products are rice, corn, and sugar. At the present time sugar cane and corn are in excellent condition, but there was a shortage of about 30 per cent in the last rice crop. The soil conditions in this municipality are suitable for the cultivation of the coconut, and this industry would be extended were it not for the ravages of the beetle.

Agricultural conditions in Capas could be much improved with more extensive irrigation, as there are two large rivers into which several smaller streams empty during the rainy season.

CONCEPCIÓN.

Of the ten municipalities visited, this is the only one in which last year's crop suffered practically no loss from drought. This was due to the fact that Concepción has two large rivers which furnish water during the entire year, as well as irrigation canals for properly distributing the water over the land. In spite of this fact, however, there are still large tracts of uncultivated land in this municipality owing to lack of draft animals.

The principal crops are rice and sugar cane, but the character of the soil is such that almost any crop might be grown.

There appears to be some difficulty over the satisfactory and equitable distribution of the water of the two rivers which flow through this municipality. Some of the landowners desire that the use of this water for irrigation purposes be properly regulated, so that every one may be equally benefited thereby.

BAMBAN.

The most important products are rice, sugar, and corn. The rice crop has suffered a shortage of about 20 per cent, but the other crops are doing well.

This municipality has a river which carries a large volume of water during the rainy season, and there was formerly an irrigation canal. This canal has been neglected and is now in bad condition. Its use, also, has not been properly regulated, and it has been the cause of many disputes among the farmers of the municipality.

The people here offer to work without compensation in digging canals, in order that they may have an adequate supply of water for irrigation purposes throughout the entire year. They desire that an engineer be sent to properly direct the work.

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SEED AND PLANT DISTRIBUTION.

MAGUEY PLANTS.

Maguey plants will be distributed free of charge to parties requesting them, for their own use, as follows:

500 Hawaiian pole plants, or
200 Hawaiian sucker plants, or
400 native nursery plants.

No free distribution will be made of over 500 plants to one person. Parties wishing larger quantities will be required to pay for them at the following rates:

	Per 1,000.
Hawaiian pole plants	₱6.00
Hawaiian sucker plants	18.00
Hawaiian nursery plants	20.00
Native nursery plants	6.00

Parties ordering plants not on the free list should send post-office money order for amount of purchase.

Literature on the subject of maguey growing in the Philippine Islands can be secured from the Bureau of Agriculture.

KAPOK.

The Bureau of Agriculture now has a large supply of *Kapok* seedlings, which will be distributed without charge to persons making application for the same. Applications should be made at once so that the trees can be set out before the close of the present rainy season.

GUINEA GRASS.

Roots of this valuable forage plant will be furnished on application. Guinea grass requires a rather high temperature, plenty of sunshine, and a soil that while moist is not too wet. Unless planted in a well-drained soil, the roots of this grass should not be set out until near the end of the rainy season.

MULBERRY.

A limited supply of mulberry cuttings can now be furnished to persons interested in the growing of silkworms.

Applicants for seeds or plants are requested to write name and address clearly, and to give full shipping directions for any material that can not be sent by mail. All communications should be addressed to the Director, Bureau of Agriculture, Manila, Philippine Islands.

G. E. Nesom, *Director of Agriculture.*

THE PHILIPPINE

Agricultural Review

VOL. I AUGUST, 1908 No. 8

CONTENTS AND ILLUSTRATIONS.

CONTENTS.

ILLUSTRATIONS.

EDITORIAL.

AN INDUSTRIAL CONFERENCE.

The President of the United States, on May 13–15, 1908, called in conference at the White House all of the governors of the different States, together with a number of other distinguished men, for the purpose of considering the question of the conservation of the natural resources of the country.

This conference has attracted world-wide attention, and its educational value can hardly be overestimated. There is also every reason to believe that it will ultimately result in great material benefit, as the entire industrial life of any people is based on the natural resources of the country in which they live. This fact was clearly and forcibly stated by Mr. James J. Hill, in an address on "The Natural Wealth of the Land and its Conservation," in which he said, "In the last analysis, commerce, manufactures, our home markets, every form of activity, runs back to the bounty of the earth, by which every worker, skilled and unskilled, must be fed and by which his wages are ultimately paid."

We believe that the White House conference offers one suggestion particularly worthy of our serious attention, viz, the advisibility of

holding a similar conference in the Philippine Islands; a conference for the consideration, not only of the conservation, but also of the development, of the natural resources of this country. There appear to be excellent reasons why there is even greater need for such a conference in these Islands than in the United States.

In the Philippine Islands we have a vast wealth of undeveloped natural resources. Our soil, forests, mines, and waterways contain the riches that will one day make these Islands a garden spot of the world. If these resources are to be developed along wise and rational lines, it is most essential that the men who are to lead and direct the work be thoroughly conversant with the nature of the problems in hand and the means by which these problems should be worked out, for it is through these men that we must expect to reach the great mass of the people.

At the present time the Government has under consideration a comprehensive scheme for the establishment of irrigation works in different parts of the country; provision has been made for the establishment of an agricultural bank; and large appropriations have been provided for the extermination of rinderpest and other animal diseases. In order that these and other measures, the object of which is the restoration of our agricultural prosperity, be effective in the fullest measure possible, we must have the hearty coöperation of our rural population. Such coöperation can not be expected until these measures are clearly and fully understood by the people.

This matter of educating our adult farmers is one of the most difficult problems with which we are confronted. The material salvation of future generations may be effected through the public schools, but in the meantime we must also consider the ways and means by which our present industrial condition is to be improved. In the United States this work of educating the farmers can be accomplished by means of farmers' institutes, demonstration farms, station bulletins, and the public press. In the Philippine Islands these measures alone are not sufficient, and, for the present at least, the great bulk of our farmers must be reached through the direct efforts of a comparatively small number of progressive and influential men, who live in the provinces and come in direct contact with the people in their daily life.

It is for this reason that something in the nature of an industrial conference is recommended. At such a conference it would be possible to bring together in one body men of public spirit and enterprise from every province in the Islands. The important industrial measures that are now either under consideration or in actual progress could be discussed in detail, and an educational campaign could be organized by means of which this information might be widely disseminated throughout the country. The White House conference has done much for the United States; it is possible that an Ayuntamiento conference would do even more for the Philippine Islands.

SPANISH AGRICULTURAL WORK IN THE PHILIPPINES.

By EDWIN BINGHAM COPELAND, *Bureau of Education.*

During the three years from 1894 to 1896 there was published in Manila a monthly periodical called the "Boletin Oficial Agrícola de Filipinas." Each year's work makes a volume of 300 to 400 pages. In each issue there were reports on agricultural research work carried on at the several experiment stations, reports on the state of growing crops and on the markets in the various parts of the Islands, exchange quotations, and summaries of foreign work in agriculture. Besides these regular features there were occasional essays on agricultural subjects, on the interest of the government in agriculture, on special crops, official decrees, maxims to cheer the down-cast farmer, reports of the exposition being held in Manila during a part of the time of publication of the Boletin, and full accounts of methods of culture of Philippine crops in other lands, especially Porto Rico.

The most valuable parts of the Boletin are the reports of the research work at the government stations. This work was really fine and eminently practical. It had hardly been published, however, before the insurrection brought agriculture in the Philippines to a standstill, and the Boletin is now a rare work and almost forgotten. The present opportunity to popularize and disseminate agricultural information is better than the Spanish Government ever had, and in this Boletin we have a large amount of the most appropriate material already prepared.

The center of the Spanish agricultural system was the school of agriculture and botany established at Manila on May 29, 1861. The Philippine Normal School now occupies the same site. There were three especially efficient experiment stations, located at Cebu; La Carlota, Negros Occidental; and Ilagan, Isabela. Work at La Carlota was begun in 1884–85, and at Ilagan in September, 1890. The Boletin contains summaries of the work accomplished during these earlier years before its publication was begun. Besides the three stations named, work, only less productive, was carried on at Magalang, in Pampanga Province; at Vigan; and in Albay and Iloilo.

Except that reports are cut up and drawn out through successive issues of the Boletin, the results of the experiments at these stations are as clearly and as concisely presented as is usual in the bulletins of the United States Department of Agriculture, and with the same

evident appreciation of the precautions necessary in order to make such work conclusive. Excellent governmental reports are not invariably preceded by work of the same quality, but in this case I believe that they are entitled to the fullest respect, for it is very evident that the men understood how their work should be done. We know that several of these stations had such equipment as the present Government has not thought of applying to the same service, and the Augustinian curate stationed at Magalang during the activity of that station has given me a more exalted idea of its work than I could get from its publications.

The Boletin contains a number of essays on general problems, that is, such as can be handled without regard to individual crops. Thus there is a paper on the influence of vegetation on local rains (Vol. II, p. 301), in which the author seems to draw some unsafe conclusions regarding rains not local. Aside from several studies of pests of single crops, there is a general paper on useful and noxious insects (Vol. II, p. 196). Locusts and means of combating them are treated (Vol. II, p. 232, and Vol. III, p. 217). A paper on methods of improving the strain of horses (Vol. II, p. 226) contains excellent directions for breeding, selection, and care. The improvement of plants and the production of better varieties (Vol. I, p. 231) is the subject of a long paper by Priego, the director of the Ilagan station. Fertilizers for single crops are studied in many places, but the general subject was most persistently hammered at by Vicente W. Pastor, director of the Cebu station. Basing his judgment on most ample study, he says (Vol. I, p. 230), "The exaggerated fertility of Philippine soils is *utterly illusory*," and (Vol. I, p. 271) "In Cebu the lands most cultivated are completely exhausted." Among much other work in this line, he analyzed the bat guano found in many caves in Cebu and tested it with a variety of crops. In different numbers of the Boletin are reports on irrigation experiments with almost all of our crops, and (Vol. I, p. 237) a general paper on the construction of ditches.

SUGAR.

Of the single crops, sugar was perhaps the most studied, receiving special attention at La Carlota, Magalang, and Cebu. In Volume I, page 166 et seq., is a study of the analytical methods in use in the sugar industry. The following are instructive extracts from copious data on the effects of fertilizers:

	Yield per hectare (kilos).	Value (₱4.76 per 100 kilos).	Cost of fertilizers.	Profit.
Check plot	6,093	₱290.02		
Bat guano	12,092	575.57	₱125	₱160.55
Manure	8,464	402.88	120	—7.14

The added yield by the use of bat guano was worth 228 per cent of the cost of the fertilizer. While the station lost money on the single crop by the use of manure, it is to be considered that the condition of the land was somewhat improved after the removal of this crop and that the use of manure by the men whose stock produce it involves almost no expense and so is immediately profitable.

In another experiment (Vol. III, p. 236), the yield from 10 ares was:

	Kilos of sugar.
Check plot	276.92
Manure	580.06
Guano	651.36
Chemical fertilizer	900.22

A rattoon crop from these roots on the manured plot, without renewed use of fertilizer, gave the largest return, about three times the check plot, but the yields from all were poor. Pastor states that in practice in Cebu a yield of 6,500 kilos per hectare is the maximum and that the average is not above 2,532 kilos. He gives the Cuban maximum as 17,704 kilos.

Fertilizing experiments on cane in cylinders are reported in Volume II, page 17 et seq.

The following experiment made in Cebu shows the effect of deep preparation of the soil:

	Kilos of cane per plot.
Native treatment	759.51
Manured	815.35
Manured and subsoiled	1,382.00

The effect of close planting was studied at La Carlota (Vol. I, p. 19), the following results being obtained with the first crop:

Distance apart of rows (centimeters).	Yield of sugar (kilos).	Remarks.
80	147.133	Unfertilized; unirrigated.
110	166.978	Do.
80	159.45	With lime; unirrigated.
110	174.44	Do.
80	148.022	Unfertilized; irrigated.
110	169.057	Do.
80	149.366	With lime; irrigated.
110	169.344	Do.

It is seen that in every case the heavier yield was obtained with the rows farther apart. In the rattoon crop the advantage of wide planting was still more evident. Lime was applied in the amount of 50 cavans per hectare. Under the particular conditions of this experiment, the lime produced but little increase in the yield, and irrigation in some cases caused an actual decrease.

Similar experiments at La Carlota another season (Vol. I, p. 225), showed that purple cane yielded 6 piculs more per hectare when planted

25,000 per hectare than when planted 30,000 per hectare. With white cane the difference was in the same direction but less marked.

White cane (Vol. I, p. 226) endures wet soil better than does purple, but otherwise the purple is the more productive.

The coleopterous insect, Melolontha, or Anoxia villosa, called Bucán in Visayan, whose larva is destructive to sugar, is discussed (Vol. I, p. 129), and the native practice of making a corral of the infected patches is strongly condemned. To get rid of the pest it is recommended that infected fields be kept plowed a year without any crop.

The directors of the stations were called engineers, and Sanchez, the director at La Carlota, seems to have been one in our sense as well as in the Spanish. He published (Vol. I, p. 161) very full and practical directions for the proper care and handling of the engines used in the manufacture of sugar. He also published (Vol. II, p. 257) a technical treatise on heating plants for sugar mills. This report gives full explanations and directions, with many diagrams, for making every part; the size and arrangement to suit local demands; and formulæ for various purposes—as, given the work to be done and the number of caguas, to find the heat required; and, given the kind of fuel, to find the size of firebox required; or, conversely, to find the efficiency of a given plant.

In marketing his sugar, the hacendero of Pandacaqui, Pampanga, put half his crop in pilones and half in fardos, and made ₱1 a picul more on the latter (Vol. II, p. 124). I believe, however, that it is still customary to market the Pampanga crop in pilones.

RICE.

Less was attempted and less of value accomplished in the study of rice than in that of sugar and tobacco. At the Albay station (Vol. III, p. 209) American plows were compared with the native in the preparation of the soil. The American plow gave the larger yield with the varieties Bacao, Bulao, Capunit, and Malagquit, but not with Siroma. Of these varieties, Bulao was found the most productive and Malagquit the least so. Soil preparation was also studied at La Carlota (Vol. I, p. 289). Incomplete experiments with fertilizers at Cebu are reported (Vol. I, p. 297).

At Magalang (Vol. III, p. 40 and elsewhere) it was found that broadcasting required 16 per cent more seed than transplanting. As to the yield, the broadcast crop, unfertilized, yielded 17.5 fold; with 60 tons of manure per hectare, 21.2 fold: the transplanted crop, unfertilized, 24.5 fold; with 60 tons of manure per hectare, 33.2 fold.

At the exposition in Manila there were shown 20 varieties of palay from Bohol, 32 from Cavite, 34 from Pampanga, 40 from Albay, 53 from Masbate, and 151 from Manila; the names of all these 151 are given (Vol. II, p. 240).

MAIZE.

Maize also received but little attention, although it was shown to be the foremost crop of Cebu, both in acreage and in product. Trial plots at Cebu gave the following yields:

Native culture	[a] 1.04
Bat guano	3.50
Manure	5.85
Lime	6.36
Manured and subsoiled	10.50

Another experiment at Cebu gave the following results:

	Hectoliters per hectare.
Check plot	38.12
Manure	44.75
Manure and bone ash	57.32

Fifteen hectoliters per hectare is stated to be a very fine crop in Cebu, and 10 hectoliters to be the average. The local weight is only 64 to 75 kilos per hectoliter, while maize in Spain weights from 72 to 80 kilos per hectoliter.

A comparative experiment at Ilagan (Vol. III, p. 374) showed the yield to be:

	Hectoliters per hectare.
Yellow native	22.8
White native	30.6
Horse-tooth	41.6

At the exposition there were exhibited, from Cebu, the varieties Talariray, Amarillo, Catursa, Bolero, and Ayta; from Ilocos, Malabago, Purao, and Lupog; from Manila, 10 varieties by the school of agriculture; and from Isabela, 16 varieties.

TOBACCO.

Valuable work in tobacco was carried on continuously by Priego at Ilagan for six years. The Boletin contains two papers on tobacco cultivation in general, and a number of papers on special aspects of the subject. Seed was imported from Havana, Connecticut, Hungary, and Sumatra, and these strains were cultivated for at least three generations. At the same time five of the local varieties were being studied. One of Priego's papers (Vol. I, p. 231) deals with selection and breeding and the question of the degeneration of imported varieties. The native varieties studied were:

Daralug, *Nicotiana tabacum microphylla*, which has strong flat leaves and has long been in local cultivation.

Vizcaya, *Nicotiana tabacum havanensis*, which has broad but not strong leaves, is very productive, and is likewise very old here.

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[a] This is more than the usual native crop on plots of similar size.

Espada, *Nicotiana tabacum angustifolia,* with leaves long and relatively free from worms. Introduced in 1848. This and the two preceding are called the best varieties.

Romero, *Nicotiana tabacum sinensis,* early and aromatic, but short-leaved and not productive. Introduced before 1830.

Pampano, *Nicotiana tabacum viscosa,* with leaves hard to use because they are not flat. Very old locally.

Of the foreign varieties, the Connecticut was satisfactory the first year, but yielded a very poor crop afterwards. The Sumatra and Hungarian maintained their quality most perfectly, but Havana did only fairly well. None of these yielded as heavy a crop as the Espada, whose product was 29 leaves per plant, with a total weight of 640 grams. In the Philippines, the Isabela tobacco is the best; the Visayan is coarse, spotted, and strong; that of Nueva Écija, fine but yellowish and rather bitter; that of Ilocos, thick, brittle, and rather incombustible. Sumatra tobacco is deficient in taste and aroma, qualities in which the Cuban excels.

The elements used in judging the quality of tobacco are combustibility, strength, aroma, thinness, elasticity, and color. The combustion must be easy and uniform; its being so depends chiefly on the presence of organic salts of potassium. The strength depends on the nicotine content; weakness is usually prized. A warm climate and a rich soil are factors favorable to the aroma, but in any case it must be developed by fermentation.

One square meter of seed-bed (Vol. I, p. 48) will provide 700 good plants. Worms and rot are the enemies of seed-beds; if either of these appears, destroy all plants near the focus of infection and pour boiling water on the ground. The usual density of planting in Isabela is 10,000 to the hectare. In Sumatra as many as 30,000 are sometimes planted. Priego advises planting 15,000 to 16,000. In the fields the "black worm" (cut worm) is the most dangerous enemy. It is usually worst in seasons following great floods.

With regard to the removal of tops, leaves, and branches, the following experiment is instructive (Vol. III, p. 339):

	Yield (No. of leaves).	Weight (kilos).
Check plot	2,894	121
Cut high, 18 to 20 leaves left	2,400	139
Cut low, 15 leaves left	2,150	160
Cut high and low, 12 leaves left	1,728	132
Cut high and low, 9 leaves left	1,198	127

The increase in value due to trimming to 15 leaves was 46 per cent.

Fertilizers for tobacco are discussed in many places (Vol. I, p. 268, etc.; Vol. III, pp. 242, 304, 336, etc.). Of manures, sometimes carabao,

more often horse, was found to be the most beneficial, the latter producing the most lasting improvement. A mixture of manure and bone meal was found the best of all fertilizers at Cebu. At Ilagan phosphorus was found to be the least profitable of the fertilizing elements usually needed on old land. A complete chemical fertilizer containing potash, nitrogen, and phosphoric acid improved the crop at Ilagan by more than 50 per cent. The use of ashes improved the quality, but sometimes decreased the yield. The effect of irrigation and the use of ashes appears in the following experiment:

	Product.	
	First quality.	Second quality.
Check plot	7.5	11.5
Irrigated	10	16
Wood ashes [a]	13	13
Wood ashes, irrigated	20	16

[a] Twenty-five hectoliters per hectare.

Still more marked results were obtained by the use of tobacco ash. As a rule irrigation increased the yield, but its effect was less marked on the first quality.

A history of the tobacco industry is begun in Volume II, page 297. During the last year of the Philippine tobacco monopoly the Government's profit from it was ₱3,000,000.

According to Pastor (Vol. III, p. 327), the maximum crop to be expected from the methods in use in Cebu is 403 kilos per hectare. The average is only 150 kilos—only 10 per cent of the average American crop.

The culture of tobacco was undertaken at La Carlota, and found impracticable because of the chance of rain at every season.

ABACÁ.

The work on abacá was very largely done at the Albay station, although (Vol. II, p. 214) it is recommended as the most promising crop for Negros.

A description of the principal varieties in Albay is given (Vol. I, p. 368), and an attempt is made at a botanical classification of the fiber-producing plants of the genus *Musa* (Vol. II, p. 332), the following four "species" being listed: *Trogloditarum textoria, Trogloditarum errans, Paradisiaca compressa,* and *Paradisiaca magna,* the last of which has only weak fibers. The variety called Samina in Luzon and Inusa in the Visayas is *Paradisiaca compressa.* Our other varieties are all *Trogloditarum.*

Abacá was cultivated in Mindanao in 1686, according to Dampier, but apparently not in Cebú at the time of Magellan's visit nor at the other places visited by his ships.

In the "trunk" of the plant 92 per cent is water. Of the dry weight, 16 per cent is ash; of the ash, potassium and sodium make up 27.5 per cent, and a total of 70 per cent is soluble. In the fiber on the market there is 14 per cent of water; the ash is only 4 per cent of the dry weight; and of the ash, potassium and sodium make 28 per cent, 51 per cent is soluble, and 15 per cent is silica. The plant obviously needs much potash.

Fertilizer experiments were begun in 1895 but apparently not completed. It is recommended that the refuse from cutting and stripping be returned to the soil.

The climatic condition most essential for abacá is constantly moist air. A moderate rainfall is sufficient if well distributed. Shade checks the loss of water but in some other respects is prejudicial. Shade trees should root deeply, "so as to bring water up to the surface where the shallow-rooting abacá can get it." The favorite shade trees are narra, ipil, molave, dapdap, and pili. Abacá thrives up to an altitude of 400 meters. With regard to the land, a heavy hillside is desirable, because it will hold much water, but, being sloping, it will not fill with water so as to smother the roots. Other land is adapted to this crop, *if used with judgment.*

Reproduction is, in practice, exclusively by suckers, but the use of tubercles and seed along with suckers is strongly urged. Clearing the land well makes it take more plants. Cultivation in advance of planting hastens the development so that it grows as much in three months as is usual in five or six. Moreover, the use of an American plow in preparing plots (Vol. III, p. 275) enabled young plants to thrive during the dry season better than they could do where the native plow was used. The use of camotes to keep the weeds down is recommended, until the abacá matures, after which the fields should be well cleaned once a year. The use of animal power is not believed feasible.

If such a procedure were practicable, the best product could be obtained by cutting over the whole field all the time, taking each shoot when it is ready. In practice, many planters cut each part of the field only once in eight months. Serrated knives were used for stripping.

Among the few enemies of abacá, drought takes first place, with wind second. The "trunk" is entered by the larvæ of two insects, whose adult forms are unknown. These larvæ, called "tamiloc" and "amasog," are not numerous.

Maximum and minimum prices from 1885 to 1894 are given, and it is wisely stated that no particular figures as to cost of production and

probable profit would be generally valid (Vol. III, p. 43). However, there is an abacá prospectus given in Volume II, p. 14.

At the exposition in Manila a model of an abacá stripper was exhibited by Nicolas Carronceja, of Daet, and two models of such machines were shown by the La Carlota experiment station.

OTHER FIBERS.

For extracting ramie fiber (Vol. I, p. 234), it is recommended that weak caustic soda or potash be used for fifteen minutes at a temperature of 80° to 100°. This frees the fiber, which should then be well washed in water and bleached with chlorate or hypochlorite of lime.

Cotton was taken up at La Carlota in 1885, but it failed at harvest three years out of four and gave a crop too small to be profitable the other time. If tried there it should be sown about the end of September. Some account of cotton cultivation in Ilocos is given (Vol. I, p. 196).

COFFEE.

As the Spanish experiment stations thrived some years after the failure of Philippine coffee and none of them was situated in a coffee district, it is natural that most of the information in the Boletin with regard to this crop should be general rather than local. There is a fragmentary history of coffee (Vol. I, p. 349); a long account of the coffee industry in Porto Rico (Vol. I, p. 209); and some information about this crop in the British and Dutch Indies (Vol. I, p. 306).

For fighting rust (Vol. I, p. 128) a 1 per cent solution of copper sulphate is recommended with, if necessary, 1 per cent of lime and 1 per cent of ammonia. The same treatment had been recommended in the Gaceta de Manila, August 22, 1893, and was copied into most of the local papers. (I have talked with many Filipino coffee growers and have found only one, Governor Losada, who had ever tried copper sulphate for this purpose. He found that it would control the rust, but gave up its use because of the difficulty in getting water to make the solution.)

At the Albay station it was found that coffee growing under bananas had yellow leaves because of undue moisture and shade. The bananas were removed and the coffee made a fresh, healthy, green growth.

Live plants of Liberian coffee were exhibited at the exposition in the spring of 1895 by Genato (which carries his culture of that plant three years or more further back than I had been told it went. It was unproductive until about 1905). Coffee was also exhibited from Paragua and Union, and there were some plants on the grounds of the agricultural school in fruit at the age of twenty-eight months from seed. The coffee crop of Negros in 1893 was 1,115 cavans.

INDIGO.

The Boletin contains a number of short notes on this crop, including a proposition (Vol. I, p. 173) to introduce it as a substitute for sugar in Negros, and a treatise (Vol. III, p. 141) in the form of questions and answers, with special reference to its cultivation in Ilocos Sur. This province is said to raise as much indigo as all the other provinces put together. The species cultivated in the Philippines is *Indigofĕra tinctoria. Indigofera disperma* is cultivated in Central America and India and is said to yield a superior product, but in smaller quantities.

Indigo is planted in Ilocos from November to February. It may be planted whenever it will receive a moderate amount of rain or can be irrigated. The seeds are sometimes irregularly scattered, but are more commonly sown in rows 12 to 18 inches apart, the seed being in bunches of eight or ten—the bunches being 9 inches apart—covered to a depth of 6 to 10 centimeters. About three days are required for germination, and the plants are cultivated when one month old. They live nine or ten months and give two to three crops; in India and Guatemala the plant lives two years.

The plants are cut when in flower and put in vats with five times their own bulk of water, submerged completely and left twenty to twenty-two hours to macerate, after which they are removed. The liquid is treated with quicklime and decanted into another vat, where it is stirred and agitated for from four to six hours. The water is then run off, and the indigo, now solid, is left behind. When a quantity of indigo has accumulated it is put into another vessel, in water, where it settles in strata, the poorest at the bottom. It is then sorted and dried. In India it is boiled with a little water before the final drying and packing, which improves the quality.

To make one quintal of first quality use 200 quintals of plants; second quality, 135; corriente, 100.

A weird assortment of measures makes this paper hard to understand; on a single page there are cavans, carretas, quintals, tinajas, and arrobas.

MONGO.

At the exposition in Manila, mongoes were shown from Ilocos Norte, Pampanga, Albay, Antique, Iloilo, Negros, and Cebu. In Cebu they are planted three or four seeds together, in November, and harvested in February. The yield is apparently not more than fifteen-fold. The enemies are rats, locusts, and some larvæ. A cavan of mongoes is 57 kilos.

PEANUTS.

The peanut (Vol. II, p. 225) is said to be a native of America, Africa, and Asia. The Spanish name is given as "cacahuete," which seems to be of Mexican origin, while the name "mani" is credited to Central America. Peanut oil was shown at the exposition, from Union. Experiments in the culture of peanuts were begun at Magalang in 1895 but never finished.

TEOSINTE.

Fine crops of this product were grown in Manila throughout the dry season (Vol. I, p. 38). The school of agriculture always had seeds for distribution. It was considered a fine fodder for both cattle and horses. "As this plant can be cut many times and is a better feed for horses than the majority of the grasses generally used in the Philippines, we can not do less than recommend its cultivation."

Directions are given for fertilizing and preparing the soil, and for sowing. It should be planted near the close of December, in rows 8 centimeters deep, 30 or 35 centimeters apart. Abundant irrigation is the only subsequent attention required. If the soil is found to have hardened it should be stirred up after each cutting. Teosinte can be cut every twenty-five days, giving seven crops before the rains put an end to it, the latter part of June. The yield per hectare of each cutting in Manila was found to be:

	Metric tons.
Manured	25
Manured and limed	30

The study of teosinte was taken up at Magalang with that of peanuts, but was likewise never completed.

BANANAS.

The varieties of bananas are discussed (Vol. II, p. 111). The chief ones listed are:

Gloria, or Ternate, the fruit with three salient angles.
Lacatan, the apex obtuse, and not angular.
Bungulan, larger than the lacatan.
Suhay Baguio, very small.
Tinduc, large, tasting like apples when cooked; yields a fair fiber.

Other varieties are Quinauayan, Tondan, Pacol, etc.

OTHER CROPS.

The mulberry is said to thrive in Negros Occidental (Vol. I, p. 173).

Among single exhibits at the Manila exposition were wheat from Ilocos Sur; sago from Ilocos Sur and Surigao; buri flour from Nueva Écija and Cebu; arrowroot from Bacolor; oil of sesamum from Ilocos

Sur and Union; and sesamum seed from Isabela, Ilocos Sur, Iloilo, and Negros.

The only place where the coconut received any attention is in a general description of agriculture in Cebu. The seeds are planted when the plumule becomes visible, in holes 35 by 25 centimeters, 4 meters apart. Dahili is a small variety which fruits in three years. The common variety, Lubi, fruits in four years.

Statistical studies were made regarding the food of laborers, showing the amount and nature of same, the carbon and nitrogen in it, and the cost. The daily cost was found to be:

	For 1 adult.	Per family.
In Cebu	₱0.10	₱0.18-.20
In Ilocos Sur	.09	.30-.35
In Isabela	.11	.30

On advance payments to laborers or labor contractors in Negros (Vol. II, p. 200) the average chance of loss was 60 per cent, and therefore such payments were usually made as small as possible.

The development of Negros is tabulated as follows:

	1850.	1893.
Population	30,000	320,000
Sugar ..... piculs	3,000	1,800,000
Rice ..... cavans	10,000	470,000
Maize ..... do	2,000	200,000
Abacá ..... piculs		16,740

The fowl and egg business of Pateros is treated in the first and second volume. There were reported to be a million ducks in Pateros and Tipas. On an average, the Europeans of Manila ate one chicken per day each, and the consumption of eggs in the city was 396.5 metric tons per year.

HORSE BREEDING IN MADAGASCAR.

By Maj. T. Bentley Mott, *U. S. Army.*

The necessity of horse breeding was felt in Madagascar from the beginning of the French occupation, and it was natural that the government of the colony should take the matter especially in hand, not only in the interest of the island itself, but for its economical development also.

The first necessity felt was that of supplying the corps of occupation with a means of renewing their saddle and draft horses, whose numbers had been sorely reduced during a hard campaign and the first period of occupation. There were other reasons for encouraging the use of horses both by officials and natives, one of them being the scarcity and consequent expensiveness of other methods of transportation, while the numerous expeditions throughout the island, the utility of establishing relations with the natives, the great distances to be covered, and the difficulty of obtaining carriers, all contributed to render urgent the solution of the problem.

The local government's programme for the construction of highroads between all important points in the island was another reason why horse breeding by colonists and natives should be encouraged. The soil of Madagascar is such that even after the completion of such roads it would be a long time before mechanical traction supplanted animals as the chief means of transportation. There are an enormous number of people in Madagascar who follow the profession of carriers, or "bourjans," and who are good for nothing else. By reason of the terrible loads they carry, these people are soon worn-out and the rate of mortality among them is very high. For philanthropic reasons, therefore, as well as for colonization purposes, it was necessary, even essential, that horses should take their place in the transportation system of the island, thus securing for agriculture the manual labor of which it stood so much in need.

All these general considerations suggested to the governor-general the proper measures to be adopted in order to produce a race of animals capable of fulfilling the necessary requirements. Everything, however, had to be done *ab ovo*. There were few horses in the island in 1896,

not more than 500, most of which belonged to the expeditionary corps, and it is certain that horses were quite unknown there in 1810. The first horses undoubtedly came from India. Later, Zanzibar, Mauritius, Cape Colony, and even Australia supplied specimens which became acclimatized and after numerous crossings produced a special and suitable breed, which the French found in the Provinces of Imerina and Betsileo. It is difficult to say which type of horses they resemble the most. They are quick, sober, and strong, rather irregular in build, not more than 9.84 hands high, and have very graceful limbs. They have often been compared to the Tonkin horse, which has an excellent reputation, and are capable of rendering as good service as the latter, but their scarcity in 1896 and the natives' ignorance of the care of horses had done much to deteriorate the race.

Competent persons, however, were of opinion that the horses found in the island should constitute the nucleus of the future race. It would have been unwise not to take advantage of the acclimatization of the breeds previously imported, and to introduce other species, stronger and better-looking perhaps, but whose acclimatization would require many years to accomplish. The first examination had shown that about three-fourths of the animals then existing in the island were mares, and it was decided that the best method would be to cross-breed these with well-chosen foreign stallions. According to the law of nature which prescribes that the offspring shall inherit the salient qualities of its parents, the new breeds would possess the *finesse* and fine blood of the stallions and the sobriety and strength of the mares.

It was also possible, of course, to try the direct importation of horses into Madagascar, acclimatizing them and so adding to the existing numbers. Perhaps it would be possible to import a new race which would become acclimatized without losing any of its characteristics, and the experiment had to be tried. The results showed, however, that all such attempts would be unsuccessful for at least some time to come.

It was also thought possible to import mares to obtain, by judicious cross-breeding, suitable breeds. The experiment has been tried, but so far the first method seems to give the best results.

Starting from the principle of crossing native mares with foreign stallions, which kind of stallion would be more suitable? By taking into consideration the qualities belonging to the native mare, the Barbary stallion was thought to be the most suitable for reproduction purposes. The size of the stallion had to be proportionate to that of the mares. Barbary stallions are generally not very tall, measuring as a rule from 14.1 to 14.5 hands, which is the height required. Moreover, it was necessary to cross a sober and hard-working mare with an equally strong stallion which would not be too exacting in the matter of food. For the eating capacity of the animals was also to be considered in a country

where food is not always abundant or very rich in quality. Barbary stallions possess the required qualities and so they were chosen to create the breed on which so many hopes were founded.

The importation of mares was, however, the first measure resorted to. The remount commission, created on October 19, 1896, sent out from France at the end of that year a number of mares destined to form a breeding establishment, and that this work was seriously undertaken is shown by the fact that on March 20, 1897, five months afterwards, the breeding establishment of Ampasika was created.

This place was built beyond the Ikopa River and near Andobata, on a sort of plateau overlooking the river, on an estate formerly belonging to Ratsiamanga, about 10 hectares of land protected by dams from flood. The vegetation on the banks produced all the necessary grass during the wet season and in the dry months the damp ground always produced enough forage.

In July, 1897, thirty Anglo-Arab mares, bought by the breeding establishment of Tarbes, were sent to Tananarivo. Much care had been exercised in their selection and every one was a perfect specimen of its type. They were of pure, or nearly pure, Anglo-Arab blood, with fine conformation, height varying from 14.5 to 15 hands, and possessing all the qualities required for the purposes of reproduction.

The experiment was unsuccessful. Notwithstanding the great care bestowed upon them, the mares suffered very much from the change of climate, and were also decimated by a disease which is the greatest obstacle to the importation of foreign horses in Madagascar. It is called osteomalacy.

This malady is a cachexy of the bones, a weakening and deterioration of the skeleton, and is caused by the lack of a sufficient proportion of lime phosphates in the soil and consequently in the vegetation growing there. This nearly total absence of lime salts in the food supplied by the soil prevents the animals from compensating for the wear of their systems and they gradually fade away and die of a sort of consumption. It is not hard to understand how difficult it is for the animals to subsist on food which is not sufficiently rich for their development, and how colts born of mares suffering from this disease are doomed to certain death.

The imported mares were stricken with this affection, and in 1901 there only remained fourteen, of which it was easy to see that one-half would soon die. Nevertheless, by crossing them with Barbary stallions several colts were obtained, of which the greater part died. In January, 1901, there only remained sixteen fit specimens, a very small number when it is remembered that all the mares brought out were first-class reproducers and had received the very best possible care.

The experiment was repeated several times, always with the same discouraging result, and the idea had of necessity to be abandoned. The

first plan mentioned above was therefore returned to, viz., to cross native mares with Barbary stallions. It is from this time that horse breeding really started in Madagascar, and the general government, not knowing under what exact conditions the work was possible, took measures to have it carried out immediately.

On November 19, 1897, the governor of the colony issued a decree by which stallions were placed at the disposition of the breeders of the Imerana Province. A permanent station was created at Tananarivo and traveling stations came to the principal centers. This decree also instituted the following bounties:

1. An indemnity of 100 francs for installation expenses to every owner of five or more 3-year-old mares suitable for breeding purposes.

2. A premium of 5 francs to every breeder bringing a mare to the state breeding establishments.

3. A competition to take place every year at Tananarivo in which all mares with colts would be entered and prizes given for the best results shown.

The same decree regulated the conditions for the sale of colts of subventioned mares and instituted a control service in charge of a committee of supervisors.

In addition, the local government caused the exact number of horses to be taken and gave the natives all necessary advice, care was taken of the animals by the veterinarians, and, in short, everything possible was done to make the work a success.

The horse-breeding department was placed under the direct supervision of the general government, so that the subject would receive as much attention as agriculture, industry, and commerce. Veterinarian Rey had the management of this branch, and he did everything possible to make it a success. He was of opinion that the native mares should be made use of and that all imported animals would invariably die, so long as the soil and the chemical composition of its products remained the same. All of his attention, therefore, was given to the question of crossing native mares with Barbary stallions.

He felt sure that the strength and endurance of the latter would enable them to successfully resist the disease, if they were attacked at all, and time has shown this to be true.

In July, 1899, he brought from Algeria into the Province of Imerina thirteen Barbary stallions not less than 5 years old; that is, having reached their full development. They reached Ampasika in September and were first used in November, when they were crossed with the imported mares mentioned above, and satisfactory results would perhaps have been obtained had these mares not been so worn-out When crossed with native mares the success was better and better.

In the beginning the native proprietors seldom brought their mares to the government farms, and when they did begin to do so it was under very unfavorable conditions. So much so that during the season of 1899–1900 out of 121 trials only 14 colts were obtained.

During the season of 1900–1, of 141 mares covered, 46 colts were dropped, which was a remarkable improvement. In 1901 the stallions showed signs of pathological injuries to their frames and though they had resisted osteomalacy better than imported horses of other races, still they were stricken with it, and at the end of that year there remained only two serviceable ones. Dr. Rey now had eight more brought from Algeria, one of which was sent to a different place and will be mentioned later. This left 9 stallions for the Ampasika farm, which produced 40 colts in 1902 from 172 crossings, or a percentage of 23.

Ampasaka to-day supplies all the horse breeders within a radius of 15 kilometers, as well as a temporary station at Autsirabe, in the breeding season, which in Madagascar is during May and June or October and November. On their way back from this temporary station the stallions remain for a time at Tsiafaby, where they are placed at the disposal of the horse breeders of Ambatolampy and Manjakandriana and neighborhood.

The impetus given to this work by Veterinarian Rey soon had its effect and proprietors began to bring their mares in quantities. The governor-general, seeing that the principal object was attained and multiplication now assured, stopped the premium of 5 francs which had been offered at first as an inducement for the people to bring in mares.

In 1901 another important measure was adopted. The Province of Betsileo presented the same natural advantages and being a well-populated district with good pasture and grazing land, it was necessary to introduce horses there also. Moreover, by giving the natives here saddle and draft animals the government would be opening a way of communication with any part of the island. According to the reports of Administrator Besson, the neighborhood of Fianarantsoa was recommended as being suitable for breeding trials, owing to the rich grazing land, well-irrigated and supplying abundant grass at all times. The few horses living and bred in that district heretofore had done fairly well.

As early as 1897 M. Besson had foreseen the possibility of utilizing these natural advantages, and having obtained three Tarbes mares and an Arab stallion, originally destined for Ampasika, he started a very small breeding establishment in Fianarantsoa, but the results were bad, all the animals being stricken with osteomalacy.

In 1900 Colonel Liancy, in command of the southern district, was instructed by the governor-general to make fresh experiments on a larger

scale. He decided, therefore, to erect a horse farm in the Alakamisy district in the middle of the Iboaka valley, 19 kilometers north of Fianarantsoa and near the crossing of the roads leading to the towns of Tananarivo and Mananjary. The quality of the grazing land near these roads was the chief reason for choosing this place. The management of the farm was given to Lieutenant Charles Roux, C. C. His assistant, Veterinarian Tatin, went to Algeria and came back with two stallions and twenty-five Arab mares. This was a return to the experiment with imported mares, which had given such poor results at Tananarivo, but as this place was 400 kilometers distant it was thought worth while to repeat it. Although these mares were full grown at the time of their importation, some of them have already been stricken with osteomalacy and it is probable that the others will share the same fate sooner or later. In the meantime, however, they will have given a number of colts which, being born in the colony, will, it is hoped, possess all the qualities of the Madagascar race.

The breeding farm at Iboaka, to which one of the new Barbary stallions was sent by Dr. Rey upon his return from Algeria for the second time, has been of much use in the south, having done a great deal for horse breeding there in general, besides determining the same movement as in the Tananarivo district.

At the present time there are two breeding establishments situated in the most populous districts. Dr. Rey does all he can to favor this industry and gives horse owners all necessary advice and instruction.

The question of the importation of horses has not yet been definitely settled, and many breeders are experimenting with imported animals. During the last two years Madagascar has received animals from France, Algeria, Harras, South Africa, and Australia. The government of the colony has also been making experiments, and in 1901 Dr. Rey on his return from Algeria bought at Djibouti thirteen Abyssinian horses which had been brought from Ethiopia.

So far the result of all the work done goes to prove that all imported animals, after resisting for a certain time, finally fall victims to this disease of the bones. Artificial means have been tried at Ampasika to overcome this difficulty. For instance, thirty grams of biphosphate of lime are given daily to each imported horse. It is too early yet to say what the result will be.

The question of food has always received the special attention of the veterinary service. This difficulty is only serious in the central regions. Along the coast and adjacent land osteomalacy is absent, probably on account of the chemical composition of the ground and consequently of the vegetation. Moreover, it is easy to bring from France everything necessary in the way of fodder. But on the central plateau such a course is difficult and expensive, especially in dealing with large quan-

tities. Therefore, what is wanted is some kind of manure which will make the soil richer, or to find some grass that will not lose, in an arid soil, its strengthening and sustaining qualities. And it is only by means of continuous trials that such results can be obtained.

A report of the governor of the Diego-Zaurez district, in October, 1902, states that a grass has been found on the Amber mountains which is as good as any imported one. It is to be hoped that the central regions will soon meet with some success in this direction.

The solution of these problems is work to be achieved mainly by the veterinary service. So far all has been done in this line that could be done to preserve, with their qualities, the horses on the island.

Frequent lectures given by the local administration and the example set by the establishments at Ampasika and Iboaka contribute to give the natives a thorough knowledge of horses. They are cautioned against making use of old horses or young stallions with blemishes and fathers of actually unfit specimens. They are shown how much better it is to cross their mares with the stallions at their disposal on the farms, which are well-taken care of and are fit specimens. They are taught to feed the horses properly with plenty of food and to occasionally give them corn, paddy, beans, etc. Sanitary arrangements and the care of horses, cleanliness, etc., are also specially demonstrated.

The exhibition held at Mabemasima was a proof that these efforts have met with success. The natives of Madagascar are now great lovers of horses and are only too proud to possess and show a well-kept stable with horses in splendid condition and this sentiment has been a great help. But it will take a long time yet to make the use of horses general all over the island, though the present results are as satisfactory as could be expected.

Judicious selection, successive crossings, and continual surveillance have been the main factors in giving Madagascar its present type of horse. These animals have an elegant shape, are well made, stockily built, and have the strength and sobriety necessary for the climate of the country. They combine most of the qualities of a good service horse with those necessary in a semitropical, uncultivated country where the food is generally poor in quality.

The increase of these horses has already opened a flourishing branch of business. At the time of and immediately after the French occupation it was usual for any kind of a horse to bring at least 1,000 francs. Now excellent ones can be secured for 500 or 600 francs and the Madagascar horses proper do not sell for more than 800 or 900. These prices are getting lower every day.

Everything will probably be done to make breeders and owners persevere in their present work. They benefit themselves while helping the colony, and the moment can now be foreseen when the colonists will

be able to get along without coolies to carry them around in sedan chairs, and all freight will reach its destination faster than if carried by these men. The government has also examined the possibility of supplying each district governor with a horse, which would certainly be a great economy over the present system, and it is probable that before long a body of mounted police will render much better service than at the present time.

The colonization in general, finances in particular, and even the preservation of order in the country depend largely on the extent to which horses are used. The results so far shown go to prove that the right solution is near at hand.

Working to the same end as the veterinary service, but in another way, Lieutenant Lobez has, since a year and a half ago, done everything in his power to further this matter. Leaving the veterinary service in charge of the breeding and similar work, he undertook to teach the natives equitation. It was not easy work and the hardest part of it was perhaps to find pupils willing to submit to the discipline necessary in order to profit by the lessons. He recruited his pupils from the superior native classes and the example was first set by young men of rather good social standing. These encouraged those of the poorer classes to begin and very soon a great number of young men attended the classes, and regular riding lessons were given several times per week at the Mahasima establishment. The instruction was both theoretical and practical. Some pupils have become first-class riders and all show much perseverance and capacity.

Lieutenant Lobez also published books treating of all questions, from breaking in to veterinary care, as well as how to ride. These pamphlets were translated and given away among the population. It may be added that illustrations and simple and explicit explanations did much to give the readers more interest in and a better understanding of the work.

This double work has done much to help the local government. Proprietors to-day make it a point of honor to show the best specimens and horses better cared for than others. The progress made in cavalry art will also benefit the horses. The distinction that has been bestowed upon many of the natives for their work with horses will be an incentive, and the best breeders and proprietors of the future will certainly come from the young riders of to-day.

AGRICULTURE AND SCHOOL GARDENS.[1]

By S. C. KELLEHER,
Instructor in agriculture in the Philippine Normal School.

Agriculture is the greatest and most fundamental of all industries. On the successful prosecution of agriculture depends the continued existence of the whole human race. In these Islands more than any other place, the people must get their sustenance direct from the soil. Therefore, education should inspire a love for the land, for plants, and for their culture. If it is the purpose of the school to be of the greatest value to a community, it must connect the affairs of the school with those of real life; it must direct attention to principles which underlie the occupation which houses, clothes, and feeds us all.

More clearly than ever before men are beginning to recognize that a healthy social life must be closely connected with nature. They are beginning to realize that only on the farm is it possible to live a wholesome, happy, and independent life. It is on the farm that one is his own boss; it is on the farm that one fixes his own hours; and it is only on the farm that one can be sure of a permanent position.

To-day in the Philippines, there is a tendency for the young men to seek clerical positions. This is a fact to be deplored, for in a very short time these positions will be filled to overflowing and then clerical wages will be so poor that they will be mere pittances.

In the United States it has been clearly demonstrated that an agriculturist or tradesman can make more than double the amount received by those holding clerical positions. Besides, the agriculturist works among nature's choicest surroundings, enjoying the greatest freedom of thought and action, while the clerical men with anæmic faces, shut away from the outdoor world, are wearing out their lives counting up the profits of some other men in "smelly ledger books."

When these people think of the farm, great dark specters loom up in the background, and they fancy an endless chain of trouble linking them to a life of drudgery. This is the effect of perverted minds. If through ignorance they have grown up to see ghosts on the farm, they

[1] An extract from an address delivered at a teachers' meeting in Bulacan Province.

will see ghosts, but if they see with minds trained by modern agricultural science, these specters will fade away like vapor in the noonday sun.

What we need is new life, training, and modern farming. In the old system of agriculture, the farmer tilled his soil and planted his seed; if it grew, it grew, and if it didn't, it didn't, and the failure was ascribed to the will of God. In modern farming if a seed does not grow, science wants to know if it was especially bred for a propagating seed, if it was tested before it was selected, and if it was disinfected before it was planted in a soil which its nature specially needed. Then if the farmer says that the fault was in the soil, science has still more pointed questions and drastic remedies. The nature of the soil, too, must be considered for "the ground is not a grave where death and quiet reign: it is the birthplace where the cycles of life begin anew to run their courses."

Many farms grow only a crop of mortgages because their owners do not know how to manage them. The unintelligent farmer in every land and age has sunk to the level of a stolid and unprogressive peasant, and in this way, in spite of the efforts of great statesmen and philanthropists, the general level among farmers has been kept very low. In such countries as Palestine, where once the land was so rich that it was said to flow with milk and honey, the soil has been absolutely ruined by mismanagement.

It is the untrained mind of the farmer which holds him down to a dull routine, keeps him in isolation, and condemns him to a life of comparative poverty. The farmer needs to be educated and trained in his work. The education that he needs is the one which will give him some real appreciation of the progressive and scientific spirit of the age in which he lives; one which will arouse a keen interest in the facts and principles of science as related to his own vocation; one which will show him that in agriculture is an ample opportunity for lifelong studies to refresh and delight the mind as well as minister to material success; and, in general, one which will lift agricultural practice out of drudgery into the domain of an intelligent profession.

A few decades ago when a person was so stupid and ignorant that he could not do anything of value, he was thought a fit subject for the farm. Most of the farmers were poor and ignorant with no hope of being anything else. It was that kind of men which ruined the most fertile soil of the world. To-day there is no room on the farm for such people—they have gone, or are going, to the cities where they will have masters to boss them.

Agricultural science and modern farming have brought about a great transformation in farm life. In the United States I am personally acquainted with several farmers who, ten years ago, were not worth a

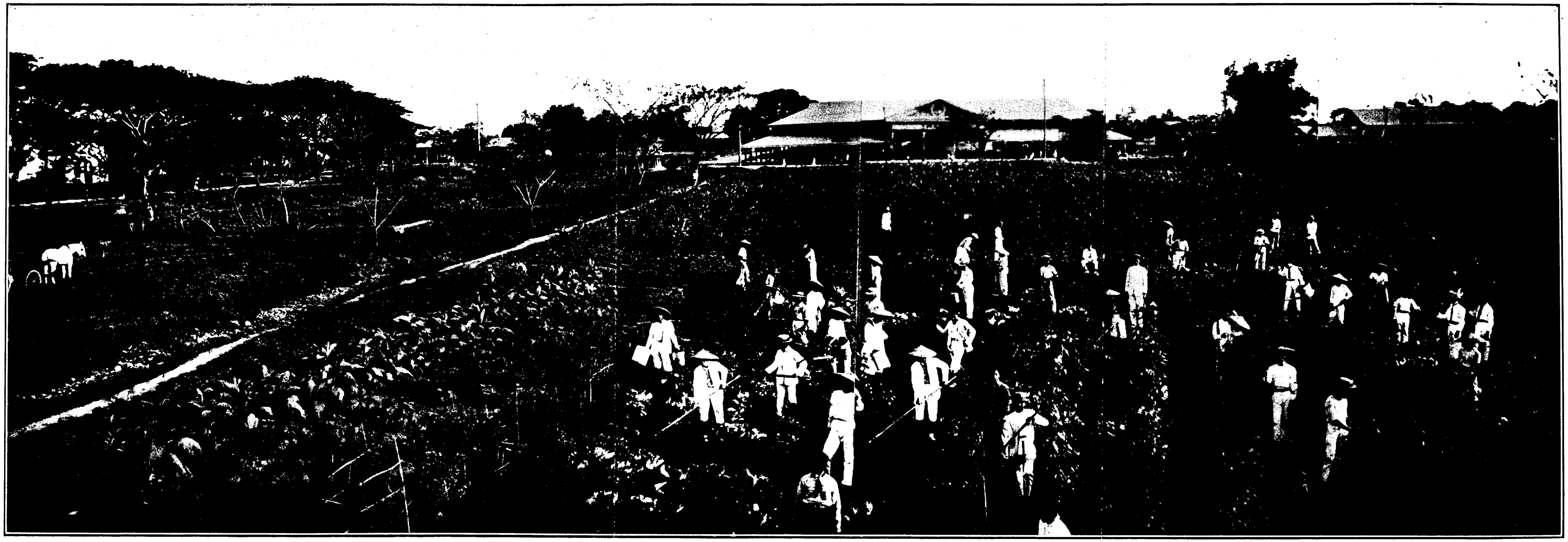


PLATE I.

peso; to-day these same men are each worth from ₱10,000 to ₱40,000. I am also acquainted with several men who hold clerical positions, but none of them are making much more than a living, and most of them are wishing that they knew how to farm, their fondest hopes being that they will some day own a piece of land.

More of health, wealth, and wisdom comes to those intelligent people who dig in the soil than to those who give time to other diversions. The child, woman, or man who works over a little plot raises more than flowers, lettuce, or radishes; he raises renewed courage in life, temperance, discrimination, and a host of other physical and spiritual crops. He sees deeper into life and feels the real influence of nature. History is full of great men who found immeasurable joy in digging and planting the soil.

The education of to-day should be of the kind that prepares the youth to overcome the difficulties that stand in the way of his material and spiritual advancement; an *education* that opens his mind and lets the world in through every natural power of observation and assimilation; an education that cultivates hand power as well as head power; an education that insist on the performance of duty to self and to others; an *education* which brings the conviction that the only way to win and keep the prizes of life, namely, wealth, culture, leisure, honor, is an ever-increasing usefulness, and brings the feeling that a life without service and without growth is not worth the living.

As teachers, we have a great task to perform, and the best way that we can begin this great work is by establishing a school garden at every school in the Philippines. We must make our school gardens centers of attraction. It is the work of this character that will make the barrio school a spiritualizing force, and create new ideals of life and worth.

By establishing good school gardens and training the child to appreciate agriculture and rural life more can be done toward promoting thrift and industry than can be done in any other way. These school gardens would lead up to a scientific agriculture which not only tends toward vocation, expertness and success, but is promotive of manhood and efficient citizenship. The result would be so great that it would be hard to measure its influence. It would be the greatest treasure-house of pedagogical material in existence.

When every barrio school has its garden, when every child is studying agriculture, and every boy with instincts along agricultural lines is being given an early opportunity for the largest development of which his nature is capable, who will doubt but that a body of people grown up under such influences, trained as they will be in rural home making, will be able to push the Philippines and Philippine agriculture to altitudes yet undreamed.

In the United States scientific agriculture has made more progress than any other country in the world. Grains, fruits, and vegetables of many kinds have been improved in various ways. The agriculturists are making two blades of grass grow twice as large and with double the nutrition of the one blade that formerly grew. They have bred corn that grows with two ears to each stalk and each ear larger than the one that formerly grew. They are producing fruits which in size and flavor have no equals. They have produced a potato which has practically revolutionized the potato industry in the world.

These improvements have been brought about by scientific work, by breeding; by selection, and by culture. Scientific plant breeding is still in its infancy and its possibilities are as boundless as the work is fascinating.

In the Philippines there are many opportunities and a great field open for the plant breeder. We need better vegetables that will adapt themselves to this climate, we need corn that will produce larger and better ears, we need sugar cane that will grow larger and contain more sugar, we need a coffee plant that will resist fungous diseases, we need better tobacco, better fruits and a higher grade of rice. Every economic plant in the Philippines can be improved; and to improve it, we need trained and capable men.

Therefore, if from all the boys in the Philippines we can find one who, after having been trained in plant culture, is able to metamorphose the field or the garden with the natural plants of the Philippines transformed to rich and succulent vegetables, a result will have been accomplished which is too grand to contemplate. The Filipino who does this will be the greatest of all his race. He will be a greater conqueror than the greatest warrior; he will have solved a more difficult problem than the greatest statesman will ever be called upon to solve; and he will make a greater gift to the Philippines and the Filipino people, than could be bestowed by the most free-handed philanthropist. His gift to his people would not be a temporary or transitory affair, but a permanent good. A gift not to one family or one generation but to all the people that ever inhabit the Philippines. Thus, we see that the result from school gardens and scientific agriculture does not end in making us better, happier, and wealthier farmers, but that there is a reward, rich beyond the calculations of the most fertile brain, held out to him who is capable.

THE SCHOOL GARDEN.

Recognizing the great necessity of some instruction in the growing of plants in every school room and a well-arranged school garden in every school yard in the Philippines, I am offering the following suggestions in order that more of the teachers will understand how to begin this class of work.

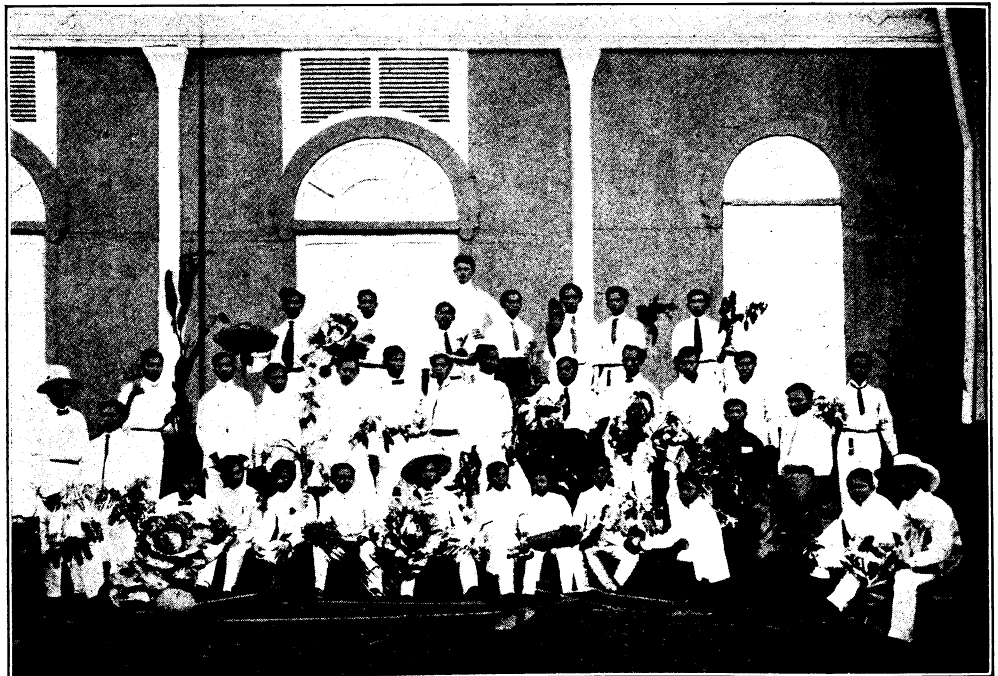


PLATE II.

In school-garden work the first thing to do is to select a piece of ground that will make a suitable garden. The site should be as near the schoolhouse as possible, but area is of prime importance and when it is possible to get a larger and better site by going a little farther away it is best to decide in favor of the larger area. The land should have sufficient slope or fall to drain off during heavy rains. The surface of the garden should not contain depressions in which water will accumulate or stand.

Having selected and fenced the site the teacher is ready to make a plat of the garden and the plots. He should measure accurately the dimensions of the garden, and then calculate the possible size of each plot, allowing one for each pupil. Each pupil should be given an individual plot, because therein lies the key to successful school-garden work. A community garden does not develop the idea of individual responsibility and each one has a tendency to care less for the plants which another has shared in producing, with a result that responsibility is shirked, and there is a lack of interest with a consequent lack of industry. The ideas of ownership, the rights of ownership and a respect for property rights come with the possession of an individual garden.

In making a plan of the garden a path should be left around the outer edge, 1 meter wide, a path between the ends of the plots, 1 meter wide, and a path between the sides of the plots, one-half meter wide. Having made a plan of the garden the teacher should draw it on the blackboard and have the pupils make a copy of it. Then he is ready to take them to the garden and mark off the plots according to the plan, driving a stake at the corner of each individual plot. These stakes should be driven into the ground deep enough not to be displaced when the ground is spaded. A plot is now assigned to each pupil, who should begin to prepare the ground for the seed and plants by clearing off all trash or weeds and then spading as deeply as possible. About a kilo of some "complete fertilizer" may then be sprinkled over each plot, or a few shovels full of well-rotted manure may be worked into the ground. Rake over the plot and break up all of the clods. It is an excellent plan to go over the ground with the hands, crumbling the soil as fine as meal. Level the bed up slightly higher than the rest of the ground and have the edges clean cut and well formed.

After the garden has been planted with the seedlings from the germinating bed, frequent shallow cultivation should be employed, but during the dry weather the depth of cultivation should not exceed 5 centimeters. A crust forming over the soil after a rain or watering is detrimental to plant growth and should be broken up as soon as the ground is dry enough to work.

THE GERMINATING BED.

In school-garden work it is necessary to have a germinating bed. This is a place specially prepared for the planting of seeds and the starting of young plants, from which they may be transplanted to their permanent position in the garden. This bed can be made of bamboo or other material, and should rest on legs like a table. The legs should stand in little pans of water or oil so that ants and other crawling insects can not harm the seed. The bed should have a shade supporting-frame over it to protect it from the direct rays of the sun and from the beating of heavy rains. This shelter can be made of bamboo with some banana leaves or cogon grass thrown on top. The covering should not be too thick, for a little sunlight is beneficial, and as the plants get larger the covering should be gradually removed.

The depth of the soil in the bed should be about 12 centimeters. A good soil for a germinating bed consists of one part of well-rotted manure, two parts of garden loam or forest mold, and one part of sharp fine sand. The manure that is used in making the bed should be thoroughly rotted, but should not have the strength leached out of it by having been exposed to weather. Mix all of the ingredients together in a heap, stirring well with a shovel, after which the soil should be sifted and placed in boxes on the germinating bed. A good top dressing for the germinating bed can be made by placing some of the soil in an oven and baking it for about an hour and then pulverizing thoroughly. This treatment will kill all the weed seed and spores of fungous diseases. Before planting the seed the soil should be well firmed or pressed down with a board. Care must be taken that the soil is not too wet or it will assume a waxy condition when firmed.

No definite rule can be given for the depth to which seeds should be planted, for this should vary with the kind of seed and with the character and condition of the soil. In heavy clay and moist soils the cover should be lighter than in sandy or dry soils. In the germinating bed seeds should never be planted deeper than is necessary to insure contact with enough soil moisture to enable them to germinate. The germinating bed should never be allowed to become dry, but great care should be taken that too much water is not applied because too frequent and heavy waterings will cause damping-off of the seedlings. With a little care and close attention it is easy to secure excellent results.

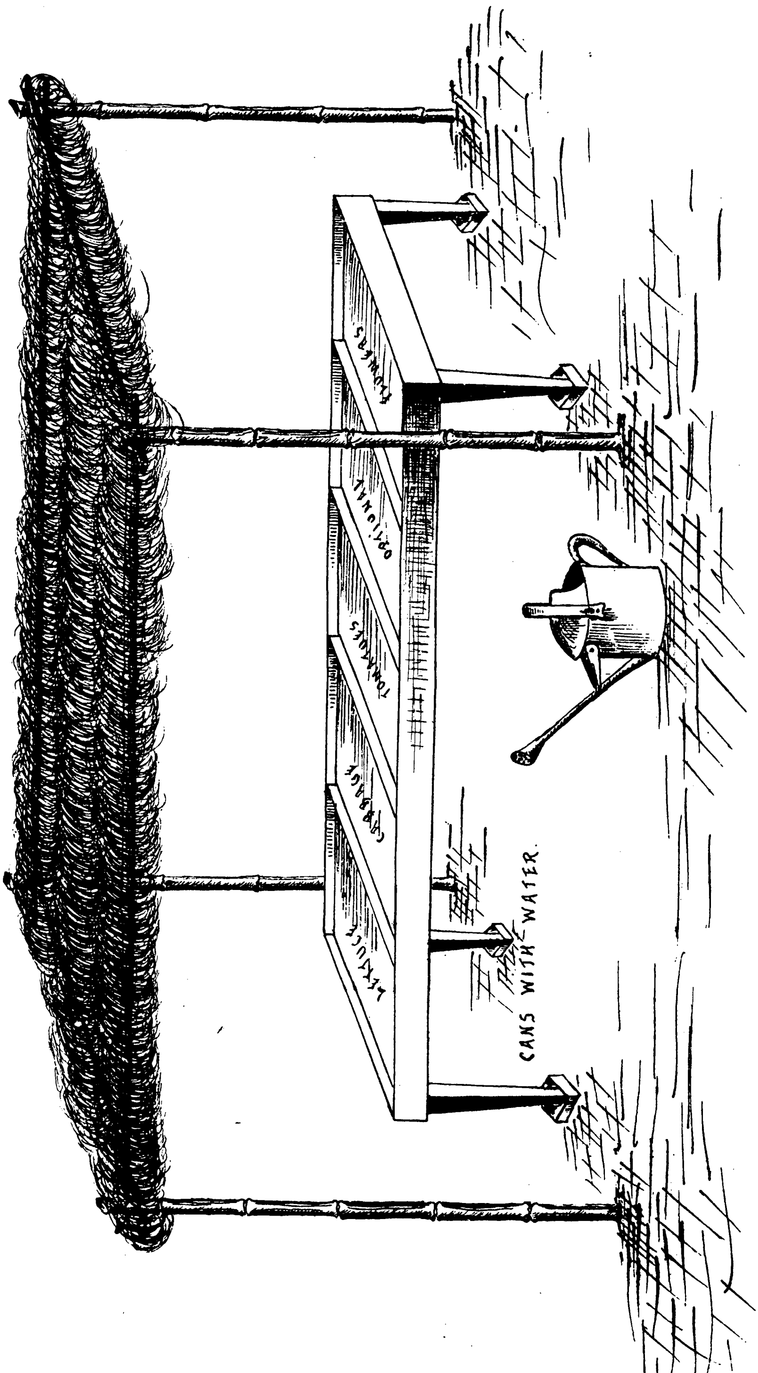
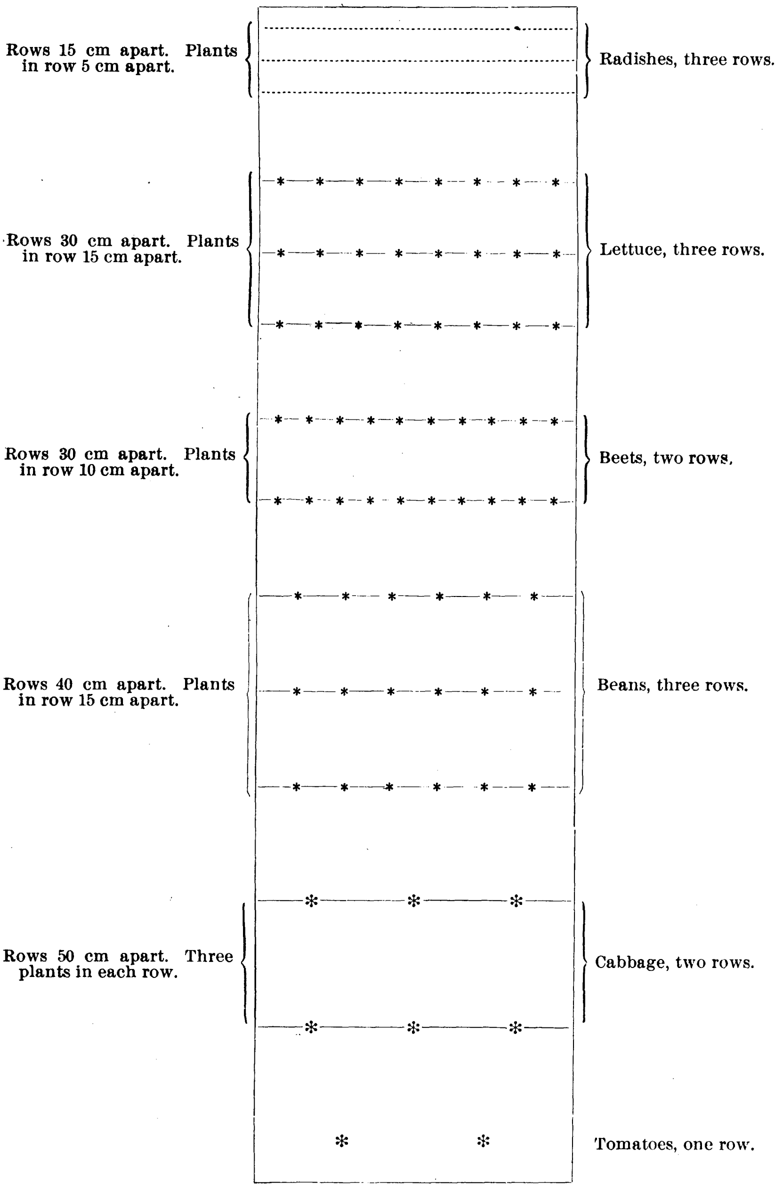


PLATE III.

PLAN OF AN INDIVIDUAL GARDEN.

[Scale, 1 to 30.]



This plan represents a plat 120 centimeters wide and 480 centimeters long. It is offered as a suggestion, rather than as a plan to be strictly followed. The availability of particular kinds of seeds and their condition will generally determine what vegetables are to be planted. Vegetables that mature quickly should be followed by others, thus giving an idea of rotation and of intensive farming.

INFECTIOUS MASTITIS OF THE GOAT.

By W. R. L. Best, V. S., *Bureau of Agriculture.*

This malady may be defined as an inflammation of the udder, apparently resulting from the invasion of bacteria.

All female animals of the mammalian type are subject to this infection, but it has been more commonly observed in the cow and goat.

The cases investigated and reported to date go to prove that the form communicated from one animal to another is caused by a pus-producing germ termed a streptococcus. There are, however, certain other bacteria which produce like symtoms and make it difficult to distinguish between the two causes. It is unquestionably true that many cases are first brought about by injuries to the udder which make it possible for the bacteria to enter the altered tissue of the skin or milk duct. Then again, we have bacteria that are able to produce toxic products which may be carried through the teat, and thus cause an inflammatory condition without the assistance of an injury to the mucous membrane.

It was formerly supposed that the sphincter muscles, situated near the base of the teat, had sufficient power to close the entrance of the duct so that it would be impossible for bacteria to enter, but this theory has been disproved by recent experiments and observation.

The inflammatory affections of the udder may be divided into two classes, acute and chronic. In the acute form, we find the parenchyma most affected, while in the chronic form the stroma or fibrous tissues are involved. The infectious form of mastitis most frequently observed may be confined to a quarter or half of the udder, but the whole gland may be attacked.

The first noticeable symptom is a marked change in the character of the milk, accompanied by the usual parenchymatous inflammation of the gland itself. The milk from the udder usually contains flaky masses held in suspension in a clear or perhaps cloudy serum, or the fluid may be streaked with blood.

A microscopical examination of the discharge shows that it contains fat cells, pus cells, red blood corpuscles, and leucocytes.

Moore states that a number of bacteria considered of more or less etiological value have been found associated with lesions of doubtful

specific origin. The results of Kit, Nocard, Mollereau, Guillibeau, Zschokke, Bang, and still others, in which a bacterium, a micrococcus, staphylococcus, and a streptococcus have been found reported as standing in a etiological relation to the trouble, indicate that a variety of microörganisms are active in producing those affections which are frequently grouped together without distinction as infectious mastitis.

A review of much of the literature on the subject shows that a number of cases reported as infectious, were isolated or sporadic ones. That is, they were in dairies where the disease did not spread to other animals. While these may be truly infectious in their nature they should be differentiated from the rapidly spreading phlegmons which are easily recognized as infectious.

If we take into account the variety of the anatomical changes which have been described in the various udder infections, we can reasonably admit that different agencies may have been instrumental in their production. The various species of bacteria which have been isolated from the udder lesions may very likely have been of etiological importance in their respective cases.

Already the fact has been pointed out that the udder is normally more or less invaded by bacteria and that certain species seem to persist in the milk ducts of the glands when once they become lodged there. If these results apply to goats generally, as rigidly as they did to those examined, an explanation of the presence of a variety of bacteria in the affected udder is not difficult to find. Whether these particular organisms under certain conditions would become primarily responsible for the disease in question, is not known.

The evidence suggests that a number of bacteria heretofore described as the cause of mastitis were in the affected gland by virtue of their presence in the normal udder. Concerning these points additional investigations are much needed.

There are a large number of morbid conditions more or less frequently encountered in domestic animals which seem to be due to infection of some kind, but which have not been demonstrated to be of such origin. These will continue to be attributed by some to infection and by others to various general causes until the truth concerning their etiology is revealed.

Infectious mastitis should not be confounded with tuberculosis of the udder. According to Bang the latter disease manifests itself as a diffuse, painless, and comparatively firm swelling; usually of one quarter (one of the posterior quarters as a rule); and more rarely of two quarters. The milk, contrary to what is the case in other inflammatory conditions of the udder, is at first normal; but it becomes in about a month, thin, watery, mixed with flakes, and sometimes, though not always, it contains

bacilli. The swollen parts of the udder become more and more indurated until at last they are "as hard as a stone." The process frequently spreads slowly from the posterior quarters to the anterior quarters of the udder. The supramammary lymph gland often become enormously enlarged.

TREATMENT.

In combating an outbreak of infectious mastitis, the observance of prophylactic measures is of the greatest importance. In the purchase of new goats, care should be exercised that they come from a herd in which the disease does not exist. If a new goat is brought into a herd, and its history is unknown, it should be milked for a week by a person who does not milk other goats. It should be kept in a separate place so that there can be no infection from litter and flooring. The udder should be washed with soap and water, followed by an antiseptic solution of bichloride, creoline, or acid carbolic. If any goat in the herd shows an inflammatory condition of the udder or teats, she should be separated at once from the herd and given a separate milker. The milk should be drawn with a milk tube, and the infected udder injected frequently with a solution of alphonzone $(COOH,CH_2,CH_2,CO)_2,O_2$, 1 to 1,000. The writer has used the above nontoxic germicide, which is an inorganic peroxide, in several cases with very successful results. In absence of alphonzone, bichloride of mercury, 1 to 1,500 or 2,000 may be used. Constitutional treatment consist in giving hyposulphite of soda in 1 dram doses three times a day.

74429——3

CULTIVATION OF MAGUEY AND ABACÁ IN THE PROVINCE OF BOHOL.

By Col. SAMUEL D. CRAWFORD, *Bureau of Constabulary.*

The Province of Bohol, with its general interest in agricultural pursuits, shows marked activity at the present time in the cultivation of maguey and abacá. The farmers of Alburquerque, Dimiao, Loay, Baclayon, and Correlia had their attention called to the benefits to be derived from maguey culture in 1906, and an interest was aroused that was due in part to the conditions prevailing at that time. These conditions were a scarcity of food supplies, or the means of getting food. At the same time the hillsides were full of maguey growing wild, and many scattering plants were to be found set out along fence lines and by the roadsides.

A fair market price for maguey in trade circles, and especially in Alburquerque, brought out 1,000 piculs of well-cleaned fiber that year. The industry appealed to the people and they began to extend their plantings. Tagbilaran has, at the present time, something like 40 hectares in maguey plants.

The free distribution of sisal plants by the Bureau of Agriculture in 1906 gave the maguey industry considerable impetus, and 10,000 plants were set out. The failure to give these plants required attention resulted in considerable loss, particularly among those planted in arid spots.

The farmers of Baclayon have been particularly active this year in planting maguey. Their original acreage of 20,000 plants has had 10,000 more added recently.

Maguey planting was first started at Loay three years ago. The farmers in that municipality now have an average of 1,000 plants each. The people of Jagna, who formerly used the maguey plants for fences and inclosures, are now planting it more extensively and in time will have a large crop. Farmers in the vicinity of Carmen are also planting maguey, each setting out from 50 to 100 plants as they have opportunity to gather them.

The people of Bohol have been cleaning maguey for many years past, using the fiber for rope. This rope has been largely for local use, but

considerable has been sold by means of the trading bancas outside of the island.

The low price of maguey has not encouraged the growers to clean much fiber this year, but interest in the culture of the plant does not abate. There is a widespread demand for sisal plants, the people believing that sisal will give more satisfactory results than the local maguey.

Abacá culture has been greatly advanced in the mountain districts of Valencia, Jagna, Dimiao, and Duero through the initiative of a few prominent planters. Numerous plantings have been made and the first results of this work—viz., 50 piculs of abacá and 10 of maguey at Dimiao, and 150 piculs of abacá at Valencia—have been sold in the local markets. The abacá is well stripped and of fine quality.

In Cornago, a barrio of Alburquerque, the people produce a small supply of abacá from which they manufacture rope for the local market. The people in and about Alburquerque clean the fiber of the sabá, a species of banana that produces a thick-skinned fruit used for frying. The fiber thus obtained is soft, fine, and lustrous, and is used for making coarse cloth. It is also mixed with silk for the production of finer fabrics.

Mayana, 10 kilometers back of Jagna, is actively engaged in abacá planting. Both the outside mountain slopes and the inside of the crater are covered with abacá plants, and there are extensive tracts planted. With the activity in planting abacá and maguey, and the cleaning of the sabá fiber, there is a corresponding activity in the making of sinamay and other cloth.

The products of Bohol are carried to the neighboring islands by the traders and are sold, or exchanged for other commodities. From appearances throughout the barrios and outlying sections pertaining to the southern municipalities, there should be no hunger or want in Bohol this year. This island is so fertile and has so much unoccupied land, it is to be regretted that more of her people do not seek their fortunes at home instead of wandering off to other islands.

The general repair of bridges from Tagbilaran to Guindulman, and the opening up of the road from Loay to Bilar in the interior, give the farmers of southern Bohol advantages for reaching the markets that are not found in many of the other islands.

RICE CULTURE IN THE UNITED STATES.[1]

Rice growing has become an important industry in the United States, notably in Louisiana, Texas, the Carolinas, and Georgia. Low-lying lands, easily irrigated and drained, naturally constitute the chief part of the area given over to rice culture, and it is stated that the best results are obtained on medium loamy soils, underlaid by a stiff subsoil. A rice that has given excellent results in the States is a Japanese variety known as "Kiushu." Carolina Golden rice is also famous for its yield and quality.

A British consular report (No. 625, miscellaneous series) was issued some time ago, giving a full and elaborate account of the methods of cultivation, irrigation, harvesting, thrashing, etc., in general practice among the rice growers of the States. The following extracts, which may be of some interest to cultivators in British Guiana and other parts of these colonies where rice is grown, have been taken from this report:

For purposes of irrigation, rice fields are surrounded by a marginal canal, and are divided up into strips of land about 50 feet wide and of various lengths by ditches which extend from the marginal canal on one side of the field to the marginal canal on the other. These ditches are about three feet wide and three to four feet deep.

The surface of the field should have a uniform grade in order to be properly irrigated. An uneven surface requires more labor, produces smaller crops, and in the end damages the crop itself. Too much water in some places and too little in others soon show injurious effects on the soil. On such a field the crop does not ripen uniformly, the field shows alternate patches of yellow and green, and the grain when harvested is found very inferior in quality. The planter whose crop is uniform in quality knows the value of applying water evenly over the entire surface. The rice lands of the Gulf and Atlantic states have a very gentle slope and do not, as a rule, require much grading.

Drainage is very essential to rice culture. Planting, cultivating, and harvesting all depend to a considerable extent on drainage. On grounds insufficiently drained planting is never well done, for the ground can not be put in condition, cultivation is greatly impeded, men can not go on the fields to work, the ground can not be stirred, and weeds and noxious grasses flourish.

[1] Published in the Agricultural News (West Indies), Vol VII, Nos 156–157.

Before the crop can be harvested, it is necessary that the field be drained. When the land is wet the harvester works at a great disadvantage, the fields are dug up by the laborers, and the surface becomes sodden and sour. On account of insufficient drainage, grain has often to be taken from the fields to some high place where it is stacked and cured.

In the Carolinas and Georgia the lands, as a rule, are prepared for planting in December and January. The ground is plowed three or four inches deep, run over with a disk harrow, and then by a roller which breaks up the clods and makes the surface level and compact. In different sections the time of plowing varies and the methods differ. In some instances the soil is so stiff that it is necessary to flood the fields before they can be plowed.

Rice is a shallow feeder. Some planters are therefore of the opinion that deep plowing is unnecessary. It might appear, however, that deep plowing would give new land each year for the plant. In upland culture the land is prepared as it is for corn, and in North Carolina the crop is raised in much the same way.

On lands that are flooded by rivers which carry a rich sediment, sufficient nutritive material may be deposited to insure its continued fertility. On lands not so favorably situated the soil becomes greatly impoverished if some fertilizer is not used. Many different kinds of fertilizers are in use in the rice belt. Among these are cotton-seed meal, dried blood, bone meal, kainit, and tankage. The last named is a special mixture for these lands. Most fertilizers contain a large percentage of potash and are spread with very satisfactory results.

Rice is generally planted with a drill in rows which are 14 inches apart, and covered by means of a harrow. The drill is gauged to put in from 54 to 81 pounds of unhulled seed to the acre. In some fields trenches about 2 inches deep and 14 inches apart are made with trenching hoes and the seed dropped in and covered. Sometimes, in what is known as the open trench method, the trench is left open in order to save time and labor, the seed having been clayed in order to prevent it from floating when the field is flooded. Claying consists in stirring the seed in clayed water until a coat of clay covers each grain.

In the North Carolina uplands the common corn drill is used in planting. Planting with a drill insures equal distribution, one of the essentials for the greatest productivity of a given piece of land. The amount sown per acre varies, the average, however, is estimated at three bushels.

One of the most important features in the culture of rice is flooding. Many planters flood the field immediately after the seed is sown, planting and watering on the same day. This first water, called the "sprout flow," protects the grain from the birds and causes germination. The

sprout flow is left on the field till the seed sprouts. In early planting this requires from six to eight days. Rice planted in June sprouts in twenty-four hours. When the sprout flow is taken off the field remains without water until the plants come up, and the rows across the field can be plainly seen when the water is again turned on. This is called the "stretch flow," and remains on the field until the plants are $5\frac{1}{2}$ or 6 inches in height. This requires from two to six days, the time depending very largely on the weather conditions. The stretch flow serves the double purpose of rendering nourishment available to the rice plant and of impeding and destroying the growth of weeds and injurious grasses.

When the plants have grown sufficiently high under the stretch flow, the water is gradually lowered to an average depth of four inches, where it remains from thirteen to thirty days, according to the strength of the soil, the condition of the plants, and the temperature. The stretch flow is taken off, and the following period of forty or fifty days, when the crop grows under dry conditions, is known as the "dry growth." During this period the crop is cultivated with horse and hand hoes. All weeds, grasses, and self-grown rice are uprooted and the ground is thoroughly stirred. It is during the dry growth that conditions are most favorable for grubs, and an intermediate flow is sometimes necessary to protect the crop from these pests.

When the plants begin to joint, the "harvest flow" is turned on. First the water is raised until it covers all the high places in the fields, and is held so for three, four, or five days, after which it is lowered to the level reached by the stretch flow. In a few days the water is again raised till it almost touches the rice heads, where it remains until the grain is ripe. The harvest flow extends over sixty-five days, and in order that the water may not become stagnant it is shifted every ten days. When the grain is ripe the heads bend low. The field is then drained for harvest.

Rice is cut when the straw barely begins to color, when the lower part of the head (about one-eighth) is still "in the milk." If cutting is delayed until the entire head is quite ripe, the quality is inferior and the quantity greatly reduced by the loss incurred by shelling out in handling.

It is cut 10 or 12 inches from the ground, leaving a high stubble on which the grain is laid to cure. In about twenty-four hours, when the grain is thoroughly dry, it is bound into sheaves, tied with straw, and shocked, or stood upright in the sun to dry. As soon as possible the sheaves are taken in carts and wagons to the thrashing mill, one of which is placed on each plantation.

Thrashing is done on nearly all plantations with a steam thrasher. The machines are stationary and very large. Thrashing mills are erected on canals or on the banks of streams, in order that boats may come to

the mill and carry the produce to market. In the process of thrashing, the grain is thoroughly cleansed by fans and screens, which remove all the light and inferior grains, chaff, etc., from the marketable article. This is then carried by elevators into large bins, where it is stored. Great care is taken that the grain be thoroughly dry before thrashing.

The rough rice or paddy, as it is taken to the mill, has two coverings —a thin, close cuticle, encased by a coarse, thick, stiff husk. Milling consists in removing these coverings. In the process 20 pounds of husks are taken from 100 pounds of paddy.

The grain is usually brought to mill in boats and taken from the boats by elevators. The first operation the paddy undergoes in the mill consists in recleaning, after which it passes between milling stones, distant from one another by about two-thirds of the length of the grain. These tear off the husks, and as the product passes over screens and bellows, the chaff and grain are separated. The grain is now placed in mortars, wherein the cuticle is removed by pounding with pestles. When the cuticle is removed, the contents of the mortar form an oily mixture of rice flour and chaff. This now passes over "flour screens," by means of which all flour is removed. The "chaff fan" is then used, and the rice, delivered as clean grain, is run into cooling bins. In the preceding processes so much heat has been generated that cooling is necessary. For about nine hours the grain remains in the cooling bin, after which one more separation takes place. By means of "brush screens" the large rice is separated from the smaller and the little flour that has not yet been removed is brushed from the grain. The product is now ready for the final process, polishing.

The commercial article is always polished. This consists in giving the grain a glossy appearance, and makes much difference in the market value. The process that gives the gloss removes much of the most nutritious parts of the grain, including nearly all of the fats and most of the flavor. The food value of rice flour is many times greater than the food value of the polished product. Polishing is effected by pieces of skins passing over the rice, and by giving a thin, fine coat of paraffin. Within a cylinder of wire gauze revolves a cylinder of wood, around which sheepskins are tacked, wool inside. This gives a soft surface, over which tanned skin, worked to a velvet-like softness, is fastened. The grain, with a piece of paraffin, is put into the large cylinder. The cylinder revolves, and passing the soft surface over the grain gives the pearly luster.

CROPS PLANTED AND HARVESTED AND CONDITION OF SAME TAKEN FROM MONTHLY CROP REPORTS FOR THE MONTH OF JUNE, 1908.

[NOTE.—Attention is invited to the fact that rice should be understood as being in the unhulled state.]

Province and crop.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Albay (reports from 10 towns):	*Hectares.*		*Hectares.*		
Abacá	303	Good	5,772	15,100	Piculs.
Coconuts		Fair		437,000	Nuts.
Sugar cane	35	Good	31	75	Piculs.
Corn	89	do	85	660	Cavans.
Ambos Camarines (reports from 23 towns):					
Corn	136	do	158	1,167	Do.
Abacá	232	do	2,280	5,965	Piculs.
Coconuts		do		90,000	Nuts.
Sugar cane	27	do	54	38	Cavans.
Antique (reports from 5 towns):					
Rice	2,521	do			
Abacá	50	do	2	10	Do.
Coconuts		Fair		2,000	Nuts.
Corn		do	700	1,000	Cavans.
Bataan (reports from 6 towns):					
Rice	290	Good			
Corn	283	do			
Coconuts		do			
Sugar cane		Poor			
Batangas (reports from 8 towns):					
Rice	11,755	Good			
Sugar cane		do		200	Piculs.
Corn	425	Fair			
Abacá		Good			
Benguet (reports from 12 towns):					
Rice	22	do	23	254	Cavans.
Corn	70	Fair	5	175	Do.
Sugar cane		do	2	22	Piculs.
Bohol (reports from 24 towns):					
Rice	2,257	Good	200		
Abacá	33	do	132	429	Do.
Coconuts		do		3,028,519	Nuts.
Corn	1,803	do	1,204	500	Cavans.
Bulacan (reports from 10 towns):					
Rice	153	do			
Sugar cane	30	do			
Corn	238	do			
Tobacco	75	Fair			
Cagayan (reports from 12 towns):					
Rice	484	Good			
Coconuts		do		10,000	Nuts.
Sugar cane	37	do			
Corn	3,964	Fair	19	12	Cavans.
Capiz (reports from 13 towns):					
Rice	7,831	Good			
Abacá	552	do	96	216	Piculs.
Coconuts		do		214,100	Nuts.
Corn	80	Fair	164	1,020	Cavans.
Cavite (reports from 8 towns):					
Rice	1,170	Good			
Abacá	30	do	6	15	Piculs.
Sugar cane	10	do	5		
Corn	15	do			

Crops planted and harvested and condition of same, taken from monthly crop reports for the month of June, 1908—Continued.

Province and crop.	Planted during month.	Condition.	Harvested during month. Area.	Quantity.	Unit.
Cebu (reports from 24 towns):	*Hectares.*		*Hectares.*		
Rice	1,429	Good		200	Cavans.
Coconuts		do		273,964	Nuts
Tobacco		do	4,642	16,194	Quintals.
Corn	9,459	do	710	18,850	Cavans.
Ilocos Norte (reports from 8 towns):					
Rice	728	Fair			
Sugar cane	20	Good	400	100	Piculs.
Corn	2,679	do	16	546	Cavans.
Maguey	220	do	50	150	Piculs
Ilocos Sur (reports from 17 towns):					
Rice	1,445	do			
Sugar cane		do	150		
Corn	4,855	Fair	42	190	Cavans.
Maguey	535	Good	200	200	Piculs
Iloilo (reports from 13 towns):					
Rice	10,600	do			
Abacá	717	do	680	2,100	Do.
Coconuts		do		79,850	Nuts.
Corn	1,253	do	2,758	19,150	Cavans.
Isabela (reports from 5 towns):					
Corn	1,350	Fair			
Sugar cane	4	Poor			
Rice	195	do			
La Laguna (reports from 13 towns):					
Rice	544	Fair	704	26,855	Do.
Corn	140	do	24	10	Do.
Abacá	36	Good	368	375	Piculs.
Coconuts		Fair		4,523,000	Nuts.
La Union (reports from 7 towns):					
Rice	134	do			
Coconuts		Good		22,000	Do.
Tobacco		Excellent	15	3,025	Quintals.
Corn	1,075	Fair	74	448	Cavans.
Lepanto-Bontoc (reports from 14 towns):					
Rice	88	Good	931	16,340	Do.
Coconuts		do			
Corn	29	Fair	490	415	Do.
Sugar cane		do			
Leyte (reports from 16 towns):					
Abacá	970	Good	7,477	16,268	Piculs.
Coconuts		Fair		1,087,582	Nuts.
Corn	2,441	do	3,207	4,005	Cavans.
Rice	1,866	Good	350	8,100	Do.
Mindoro (reports from 3 towns):					
Rice	353	Fair			
Abacá	34	Good	37	242	Piculs.
Coconuts		do		28,323	Nuts.
Corn	10	do	14	65	Cavans.
Misamis (reports from 6 towns):					
Abacá	117	Fair	838	2,502	Piculs.
Rice	484	Good	25	1,000	Cavans.
Tobacco	124	Fair	134	144	Quintals.
Coconuts		Good		176,967	Nuts.
Moro (reports from 7 towns):					
Rice	211	do			
Abacá	211	do	2,042	681	Piculs.
Coconuts		do		163,810	Nuts.
Corn	29	Fair	6	180	Cavans.
Nueva Ecija (reports from 15 towns):					
Rice	959	Good			
Coconuts		Fair			
Sugar cane		Good			
Corn	235	do			
Occidental Negros (reports from 14 towns):					
Rice	1,720	do			
Coconuts		do		59,200	Nuts.
Sugar cane	580	do	2,760	5,920	Piculs.
Corn	4,680	do	416	560	Cavans.

Crops planted and harvested and condition of same, taken from monthly crop reports for the month of June, 1908—Continued.

Province and crop.	Planted during month.	Condition.	Harvested during month: Area.	Quantity.	Unit.
Oriental Negros (reports from 9 towns):	*Hectares.*		*Hectares.*		
Abacá	300	Fair	537	697	Piculs.
Coconuts		do		396,100	Nuts.
Corn	3,500	do			
Rice	400	do			
Pampanga (reports from 18 towns):					
Rice	190	Good			
Sugar cane		do	50	750	Piculs.
Corn	750	Fair	26	45	Cavans.
Cacao		Good	10	10	Arrobas.
Pangasinan (reports from 23 towns):					
Rice	4,522	Fair			
Coconuts		Good		105,450	Nuts.
Corn	317	do	265	1,702	Cavans.
Sugar cane	8	do			
Rizal (reports from 12 towns):					
Rice	133	do	32	1,800	Do.
Sugar cane		Fair			
Corn	59	Good	65	130	Do.
Coffee		do			
Samar (reports from 12 towns):					
Abacá	114	do	1,278	3,798	Piculs.
Coconuts		do		138,304	Nuts.
Tobacco		Fair	51	352	Quintals.
Corn	38	do	54	636	Cavans.
Sorsogon (reports from 14 towns):					
Rice	1,040	Good	570	1,440	Do.
Abacá	916	do	4,643	7,491	Piculs.
Coconuts		do		80,409	Nuts.
Corn	414	do	27	96	Cavans.
Surigao (reports from 2 towns):					
Abacá	20	Fair	7	500	Piculs.
Coconuts		Good		4,000	Nuts.
Sugar cane		do			
Corn	10	do			
Tarlac (reports from 7 towns):					
Rice	4,084	do			
Sugar cane	90	do			
Corn	330	do	280	922	Cavans.
Coconuts		do			
Tayabas (reports from 16 towns):					
Rice	4,155	do			
Abacá	76	do	98	300	Piculs.
Coconuts		do		1,321,845	Nuts.
Corn	146	do	127	544	Cavans.
Zambales (reports from 5 towns):					
Rice	69	Poor			
Coconuts		Fair		5,000	Nuts.
Sugar cane		do			
Corn		Good			

RANGE OF PRICES OF PHILIPPINE AGRICULTURAL PRODUCTS.

Highest, lowest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the month of June, 1908.

Province.	Rice, unhulled state, per cavan.			Abacá, per picul.			Copra, per picul.		
	High-est.	Lowest.	Aver-age.	High-est.	Lowest.	Aver-age.	High-est.	Lowest.	Aver-age.
Albay	₱3.72	₱2.00	₱2.86	₱9.00	₱6.75	₱7.87	₱6.50	₱4.50	₱5.50
Ambos Camarines	3.50	2.00	2.75	13.00	4.50	8.75	6.00	4.00	5.00
Antique	3.12	2.00	2.56	25.00	18.00	21.50	7.50	7.50	7.50
Bataan	3.00	2.00	2.50	----	----	----	----	----	----
Batangas	3.50	2.50	3.00	16.50	14.50	15.50	4.50	4.50	4.50
Benguet	3.50	2.50	3.00	----	----	----	----	----	----
Bohol	3.50	2.00	2.75	18.00	9.60	13.80	7.00	4.50	5.75
Bulacan	2.80	2.50	2.65	----	----	----	----	----	----
Cagayan	3.75	2.50	3.12	----	----	----	8.00	8.00	8.00
Capiz	3.50	2.25	2.87	24.00	9.50	16.75	8.00	5.00	6.50
Cavite	3.20	2.75	2.97	18.00	18.00	18.00	3.70	3.70	3.70
Cebu	3.25	2.00	2.62	24.00	10.00	17.00	8.00	6.00	7.00
Ilocos Norte	3.50	2.50	3.00	5.00	5.00	5.00	----	----	----
Ilocos Sur	3.75	2.50	3.12	----	----	----	----	----	----
Iloilo	3.15	2.25	2.70	22.00	18.00	20.00	7.00	4.00	5.50
Isabela	3.50	3.50	3.50	----	----	----	----	----	----
La Laguna	3.12	2.00	2.56	16.00	8.00	12.00	7.20	5.25	6.22
La Union	3.75	3.37	3.56	----	----	----	6.00	6.00	6.00
Lepanto-Bontoc	4.00	2.00	3.00	----	----	----	3.00	3.00	3.00
Leyte	3.50	2.50	3.00	15.00	9.00	12.00	7.00	5.00	6.00
Mindoro	2.75	2.50	2.62	15.00	10.00	12.50	5.50	4.50	5.00
Misamis	3.75	2.00	2.87	10.00	7.00	8.50	6.50	5.00	5.75
Moro	3.50	2.20	2.85	18.00	6.50	12.25	6.50	4.80	5.65
Nueva Ecija	2.50	1.75	2.12	----	----	----	----	----	----
Occidental Negros	3.25	2.50	2.87	22.00	12.00	17.00	7.00	4.50	5.75
Oriental Negros	3.50	2.50	3.00	18.00	3.00	10.50	7.40	5.00	6.20
Palawan	2.60	2.00	2.30	----	----	----	4.50	4.50	4.50
Pampanga	2.80	2.00	2.40	----	----	----	----	----	----
Pangasinan	3.60	2.25	2.92	----	----	----	10.00	3.00	6.50
Rizal	2.75	2.25	2.50	----	----	----	----	----	----
Samar	3.00	2.00	2.50	15.00	7.00	11.00	7.50	5.50	6.50
Sorsogon	3.50	2.00	2.75	15.00	7.50	11.25	7.00	4.00	5.50
Surigao	3.75	2.50	3.12	12.00	10.00	11.00	6.50	5.50	6.00
Tarlac	2.75	2.00	2.37	----	----	----	----	----	----
Tayabas	3.50	2.50	3.00	18.00	4.00	11.00	5.70	3.50	4.60
Zambales	2.75	2.50	2.62	----	----	----	----	----	----

Highest, lowest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the month of June, 1908—Continued.

Province.	Sugar, per picul.			Tobacco, per quintal.			Corn, per cavan.		
	High-est.	Lowest.	Aver-age.	High-est.	Lowest	Aver-age.	High-est.	Lowest.	Aver-age.
Albay	₱8.00	₱7.50	₱7.75	₱20.00	₱8.00	₱14.00	₱3.00	₱2.50	₱2.75
Ambos Camarines	5.00	5.00	5.00				3.00	1.75	2.37
Antique	3.50	2.00	2.75	6.00	6.00	6.00	1.50	1.50	1.50
Bataan	5.00	3.50	4.25						
Batangas	4.00	4.00	4.00	9.00	9.00	9.00	3.00	2.50	2.75
Benguet	5.00	4.00	4.50				4.00	4.00	4.00
Bohol	5.00	3.00	4.00	12.50	4.00	8.25	3.50	2.00	2.75
Bulacan	6.50	3.75	5.12	15.00	6.00	10.50	4.30	2.00	3.15
Cagayan	6.00	6.00	6.00	15.00	6.00	10.50	2.50	1.50	2.00
Capiz	7.00	7.00	7.00	10.00	10.00	10.00	3.50	1.12	2.31
Cavite	4.50	3.50	4.00				2.50	2.25	2.37
Cebu	8.00	3.00	5.50	23.00	4.00	13.50	3.50	2.00	2.75
Ilocos Norte	6.00	5.00	5.50	18.00	8.00	13.00	5.00	2.00	3.50
Ilocos Sur	3.50	3.00	3.25	60.00	3.00	31.50	4.80	2.00	3.40
Iloilo	6.00	4.00	5.00	20.00	5.00	12.50	5.00	2.50	3.75
Isabela	5.00	5.00	5.00	12.00	12.00	12.00	3.00	3.00	3.00
La Laguna	7.25	3.50	5.37	4.00	4.00	4.00	3.00	2.20	2.60
La Union	2.70	2.50	2.60	9.00	3.50	6.25	4.00	2.50	3.25
Lepanto-Bontoc	5.00	2.00	3.50	4.00	3.00	3.50	5.00	2.00	3.50
Leyte	7.50	4.00	5.75	60.00	10.00	35.00	3.50	2.00	2.75
Mindoro	5.00	5.00	5.00	6.00	6.00	6.00	3.50	3.00	3.25
Misamis	4.00	4.00	4.00	25.00	12.00	18.50	3.75	1.50	2.62
Moro							2.50	2.00	2.25
Nueva Ecija	10.00	5.50	7.75	30.00	6.00	18.00	2.50	1.50	2.00
Occidental Negros	5.00	3.50	4.25	30.00	6.00	18.00	4.00	1.75	2.87
Oriental Negros	5.00	3.00	4.00	25.00	6.70	15.85	5.00	2.20	3.60
Palawan				20.00	20.00	20.00			
Pampanga	4.50	2.90	3.70				2.70	2.50	2.60
Pangasinan	7.00	3.10	5.05	10.00	2.00	6.00	3.75	1.50	2.62
Rizal	5.00	3.00	4.00				5.00	2.50	3.75
Samar	6.00	6.00	6.00	38.00	4.00	21.00	2.80	2.00	2.40
Sorsogon	7.00	1.50	4.25	12.50	7.00	9.75	5.00	1.50	3.25
Surigao									
Tarlac	5.00	4.00	4.50	7.00	6.50	6.75	2.50	1.25	1.87
Tayabas	6.25	5.00	5.62	8.00	8.00	8.00	4.00	1.25	2.62
Zambales	6.25	6.25	6.25						

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Bureau of Agriculture.

SEED AND PLANT DISTRIBUTION.

MAGUEY PLANTS.

Maguey plants will be distributed free of charge to parties requesting them, for their own use, as follows:

500 Hawaiian pole plants, or
200 Hawaiian sucker plants, or
400 native nursery plants.

No free distribution will be made of over 500 plants to one person. Parties wishing larger quantities will be required to pay for them at the following rates:

	Per 1,000.
Hawaiian pole plants	₱6.00
Hawaiian sucker plants	18.00
Hawaiian nursery plants	20.00
Native nursery plants	6.00

Parties ordering plants not on the free list should send post-office money order for amount of purchase.

Literature on the subject of maguey growing in the Philippine Islands can be secured from the Bureau of Agriculture.

KAPOK.

The Bureau of Agriculture now has a large supply of *Kapok* seedlings, which will be distributed without charge to persons making application for the same. Applications should be made at once so that the trees can be set out before the close of the present rainy season.

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Roots of this valuable forage plant will be furnished on application. Guinea grass requires a rather high temperature, plenty of sunshine, and a soil that while moist is not too wet. Unless planted in a well-drained soil, the roots of this grass should not be set out until near the end of the rainy season.

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A limited supply of mulberry cuttings can now be furnished to persons interested in the growing of silkworms.

Applicants for seeds or plants are requested to write name and address clearly, and to give full shipping directions for any material that can not be sent by mail. All communications should be addressed to the Director, Bureau of Agriculture, Manila, Philippine Islands.

G. E. Nesom, *Director of Agriculture.*

THE PHILIPPINE

Agricultural Review

VOL. I SEPTEMBER, 1908 No. 9

CONTENTS AND ILLUSTRATIONS.

CONTENTS.

ILLUSTRATIONS.

EDITORIAL.

ELEMENTARY AGRICULTURE.

There is a widespread and constantly growing demand in the Philippine Islands for publications on agriculture. The problem of meeting this demand, and of furnishing printed matter entirely suitable to the conditions which prevail here, is an extremely difficult one. A large part of the requests for printed matter received by the Bureau of Agriculture come from students and Filipino teachers, and it is probable that with the extension of educational work along agricultural lines the number of these requests will continue to increase.

During the past two years the Bureau of Agriculture has published several small leaflets containing "questions and answers" on agricultural subjects. These leaflets have been widely distributed and have been favorably received. The March number of the REVIEW was devoted entirely to a simple catechism on the common dangerous communicable

diseases of domestic animals in the Philippine Islands. The demand for this number of the REVIEW has far exceeded that for any other number yet published. These facts have suggested the desirability of publishing in equally simple form a series of articles covering both general agriculture and also subjects of especial interest to the Philippine farmer.

These articles will be written in as simple language as possible, and will be prepared in the form of a catechism. They are intended, primarily, for students who are just beginning the study of agriculture in the school room and in the school garden, and for whom there appears to be a great dearth of printed matter at the present time.

THE FERMENTATION OF CACAO AND OF COFFEE.[1]

By Oscar Loew, *Physiologist.*

THE FERMENTATION OF CACAO.

Although much has been written about the fermentation of cacao, there still exists a great difference of opinion in regard to the process, its purpose and necessity, and the kind of action involved in it.

Herbert Wright, in his exhaustive work on cacao[2] mentions yeast cells[3] as the most important organisms causing the fermentation, while other authors attribute the fermentation to unorganized ferments, others again to bacteria, and even the changes due to germination were supposed to play a rôle in it.

According to George Watt, in his Dictionary of the Economic Products of India[4]—

> The coolie dexterously strips all the beans off the center pulp. The pods are then thrown round the trees and act as manure, while the beans are removed to the fermenting cistern. It takes from five to nine days to properly ferment the cacao and it is then ready for working. It is trampled first, as in coffee, with the feet and then removed in baskets and carefully hand-washed.[5] * * * I have no doubt that before long some means less expensive will be found for washing. * * * The prices obtained for it will depend in the much greater measure on the careful attention of the curing than in the case of coffee.

Safford, writing on cacao in Guam,[6] says:

> Cacao beans are sometimes kept in jars and allowed to "sweat," or undergo a sort of fermentation which improves their flavor, but this custom is not universal. Many families, after having dried the beans in the sun, keep them until required for use, when they toast them as we do coffee, grind them, and make them into chocolate. Chocolate made from the newly ground bean is especially rich and aromatic.

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[1] From the annual report of the Porto Rico Agricultural Experiment Station for 1907.

[2] Theobroma cacao or cocoa. Colombo, 1907, p. 108.

[3] According to A. Preyer (Tropenpflanzer, 5 (1901), pp. 157–173), a special kind of yeast, which he named Saccharomyces theobromae, effects the best fermentation in Ceylon.

[4] London, 1893, vol. 6, part 4, p. 44.

[5] Such methods are followed in India, but not in America.

[6] Useful Plants of Guam. U. S. Nat. Mus., Contrib. Nat. Herbarium, 9 (1905), p. 387.

Hinchley Hart[7] writes:

> The prime object of sweating or fermentation appears to be to change the inside portion of the bean by absorbing into it products obtained from the fermenting pulp, and where this is not fully accomplished by any of the methods the bean is classed as unfermented, and the product is generally of lower value.

The changes brought about by the fermentation have been minutely examined by J. B. Harrison, chemist in British Guiana. Some of the changes observed, as, for example, the decrease of protein in the seed and the increase of amido compounds, are only incidental and not of any importance, since they do not affect the color, which is simply due to the action of a proteolytic enzyme in the seed.

The principal conclusions reached by Harrison[8] are that the process of "fermentation or sweating in cacao consists in an alcoholic fermentation of the sugars in the pulp of the fruit accompanied by a loss of some of the albuminoid and indeterminate nitrogenous constituents of the beans, * * * and some parts of the carbohydrates other than the sugars undergo hydrolysis and either escape in the runnings from the boxes in the form of glucose or undergo in turn the alcoholic and acetic fermentations." Further he declares, "During this change some of the astringent matters, to which the somewhat acrid taste of the raw beans is due, are also hydrolyzed, and thus a marked improvement in flavor is gained." Finally he adds, "This work has necessarily only resulted in a partial and incomplete study of the results of the fermentation." The so-called fermentation is carried out either by heaping the fresh seeds, after separating them from the shell, on the floor or in receptacles and covering them with banana leaves or with cloth. The floor or the receptacles slope so that the watery products can escape during the fermentation. A period of two to six days, according to circumstances, is usually allowed for fermentation. The height of the heaped seed measures 1 to 1.5 meters and over. In some countries the highest temperature allowed for fermentation is 45° C., in others, 50° C. According to Hart[9] there is "danger in allowing (the temperature) to rise above 140° F. (60° C.), as the character of the product is sure to suffer."

An apparatus has been recently devised by M. Schulte in which a constant temperature of 60° C. is maintained. In this case the yeast is fully excluded and bacteria with few exceptions also, and the necessary changes are brought on mainly by the heat, but this method has been considered too tedious and of little value to cacao planters, as is shown by Maurice Montet[10] in his criticism of the apparatus.

The rise of temperature amounts to about 5° C. in twenty-four hours,

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[7] Cacao, Trinidad, 1900, 2d ed., p. 38.

[8] Proc. Agr. Soc. Trinidad, 2 (1896–97), p. 250, Hart, Cacao. Trinidad 1900, 2d ed., pp. 106, 107.

[9] Cacao, Trinidad, 1900, 2d ed., p. 42.

[10] Jour. Agr. Trop., 5 (1905), No. 52, p. 297.

PLATE I.

and after four days the fermenting beans show generally an elevation of 18° to 20° C. above the temperature of the surrounding atmosphere. The more or less rapid rise of temperature in the fermenting pile depends, of course, upon the height of the pile and upon the temperature of the surrounding air.

The cacao fruit resembles a cucumber in shape, but the form is subject to certain variations. The shell is of violet, red, or yellow color, sometimes even nearly white, 15 to 25 centimeters long and 6 to 10 centimeters thick. The shape of the seed is more or less round, often laterally compressed or flattened, when it resembles the bean of Phaseolus; its length varies from 2 to 2.5 centimeters, the diameter from 0.8 to 1.8 centimeters. Between the fleshy and corrugate cotyledons, showing convolutions on the surface, lies the bitter purple embryo with its white chalaza. The cotyledons of one variety are white in color. There may exist in one fruit as many as fifty seeds. The loose parenchymatous slimy tissue (pulp) surrounding the testa of the seed appears to be of similar nature to the tissue forming the soft inner layer of the hard fruit shell. The structure of the entire fruit is somewhat complicated, and nature has evidently taken much pains to protect the embryo by four different envelopes.

The chief purposes of the fermentation process are:

(1) Removal or contraction of the pulp surrounding the seeds.

(2) Loosening of the connection between the seed and its testa.

(3) Development of color and improvement of taste.

Some authors hold that the heat of the fermentation is required to harden the interior of the bean, and also to pass it to a second fermentation; further, that another change consists in the hardening or toughening of the testa of the bean, whereby brittleness is avoided during drying, and thus the seeds are better protected against the entrance of mold fungi.[11] Various authors also ascribe to the fermentation a great influence upon the development of the aroma.

As regards the first of the above-named purposes, namely, the removal of the slime layer attached to the seed coat, a somewhat similar process occurs in the fermentation of coffee. The first step is the development of numerous yeast cells, which find ample nutrients in the sweet juice oozing from the pulp. The yeasts are chiefly *Saccharomyces ellipsoideus* and a certain amount of *S. apiculatus* which develop rapidly. These organisms occur on fruits, as well as in the dust of the air and on the surface of the soil, together with numerous bacteria. The alcohol fermentation of the sugar by these yeasts destroys the superficial strata of the pulp or slime tissue, and as its juice passes freely to the outside, nourishment is given to innumerable bacteria, among them the widely distributed acetic bacillus. The respiration of these organisms and the

[11] Hart, Cacao, Trinidad, 1900, 2d ed., pp. 35, 49.

fermentative activity generate heat and gradually a considerable elevation of temperature is reached.

The juice on the surface now assumes a strong acid reaction, due to the oxidation of alcohol to acetic acid, and this suffices to destroy the remaining cells of the slime layer, causing thereby a considerable shrinkage of it, and also a further discharge of juice, as the cytoplasm of the dying cells becomes permeable to the interior juice. Thus a considerable amount of liquid gathers at the bottom of the receptacles and, since this liquor has an agreeable sour smell and taste, it is used in some factories as vinegar. By the bacterial action the attached pulp is further loosened from the testa to some extent and can be washed away, as is done in Ceylon. In many parts of Central America, however, the shrunken pulp is dried with the beans, which are shipped in this condition to other countries.

The fermented and well-washed cacao beans show a uniform yellowish or brownish coloration of their testa. The testa of unwashed fermented beans do not show a uniform coloration on account of the adhering films of fermented and shrunken pulp, which has turned from the original colorless condition to violet brown color, and which is reduced from the original thickness of 0.1 to 0.2 centimeter to a mere film. An advantage of removing the remaining films by washing consists doubtless in the greater rapidity of drying, whereby the danger of attack by mold fungi is diminished. E. Lange [12] holds that the extra trouble is not compensated by the additional price obtained for washed cacao. Nevertheless the washing of the cacao has been recently introduced in Trinidad.

When the pulped cacao is not fermented, but simply dried in the sun, the slimy layer around the testa shrinks considerably, but not to such insignificant thin films as after fermentation. When the entire juice of the slimy layer is simply dried up instead of being removed, a hygroscopic condition of the product results, which in moist weather becomes sticky and might support fungus growth. Hence, fermentation is preferable to a simple drying process, and after washing yields a much cleaner product.

In the fermentation of coffee the slimy layer to be removed from the testa (parchment envelope) is much thinner that of the cacao seed. Hence the fermentation of coffee is of much shorter duration than that of cacao.

In regard to the second purpose above-mentioned, namely, loosening the connection between the seed and its testa, it must be mentioned that by the death of the seed, caused by the elevation of temperature of the fermentation to 40° to 45° C., some contraction takes place and the seed recedes somewhat from its walls. Later on, in the manufacture of cacao from the fermented and dried beans, they are roasted and some further contraction of the seed is caused. The testa having lost its

[12] Agr. Record (Trinidad), 4 (1891), pp. 105–107.

hygroscopic water by the heat, now can be easily separated, especially while still warm and brittle.

An important change also due to the fermentation process is the production of a fine brown color. The effect of the fermentation in this direction is, however, not a direct, as supposed by many, but an indirect one, and may be secured by simply drying the bean. Sun-dried beans are uniformly deep brown. When the fresh seed is cut, the surface thus opened will turn from the original violet to a deep brown color within a short time, while boiled seed thus treated will not show any change of color, even after many hours' exposure to the air. This is in full analogy with similar phenomena observed very frequently with plants, and is due to the presence of oxidases or oxidizing enzymes. When cells are killed by being cut open or in any other way that will not injure the oxidases, these will, upon the death of the protoplasm in which they were stored up, be liberated and commence at once their activity, easily recognized by the early appearance of a brown, black, or red color. These colors are generally due to the oxidation of various kinds of tannins originally present in the juice or cell sap.[13] If, however, the death of the protoplasm is produced by strong acids or boiling temperature,[14] the oxidases will also be killed and no color change will be noticed, as the tannins and other readily oxidizable matters in the juices can not easily take up the atmospheric oxygen without the assistance of oxidases.

A further control experiment was made in which the pulped cacao (seed with testa and attached slime layer) was boiled for about twenty minutes with dilute sulphuric acid of 2 per cent. The slimy tissue contracted and together with the swollen testa was easily separated from the seed. These seeds showed a pure red coloration on the outside, while the interior was violet, and no trace of brown color appeared even after many hours' exposure to the air, since the oxidizing enzyme (oxidase) had been killed, together with the living matter (the protoplasm of cells).

The seeds commence to die when the entire fruit is kept for several days at 40° to 45° C., and the browning can be observed progressing from the surface of the seed toward the interior. By becoming overripe, the soft interior strata of the fruit shell, as well as the slime tissue around the seeds, contract more or less and a hollow space is formed between the fruit shell and the seeds with their adhering slime tissue. Air diffuses into this space and the reason for the brown color produced by oxidation within the fruit becomes apparent. During the fermentation process the browning does not often go farther than this, and the interior of the

[13] Such a case is observed in the curing of tobacco, whereby a fine brown color is produced.

[14] The killing temperature for oxidases is 20° to 30° C. higher than that for protoplasm or living matter.

seed often continues to show the original violet coloration. It is then that the subsequent drying process, which admits air abundantly by diffusion through the testa, completely finishes the browning process. Some further darkening can take place during the roasting process when powdered cacao and chocolate are made from the fermented beans.

The color change of the cacao seed is no doubt similar to the color change in the preparation of black tea, for which it has been positively proved [15] that an oxidizing enzyme acting on a specific tannin is the real cause of the blackening of the leaves. When the oxidizing enzyme of the tea leaves is killed by steam, the leaves retain their green color and never turn black (green tea).

Tea leaves contain 7 per cent tannin and over, and the production of a black color from this tannin commences as soon as the leaves die, which takes place when they are kept in heaps after picking and are deprived of sunlight (death by starvation). Indeed, black tea contains less tannin than green tea. In order to increase the black coloration the leaves are rolled, which brings their juice to the surface, and the access of air accelerates the blackening process.

A case in which tannin is changed by partial oxidation for the sake of removing the astringent taste is observed in the curing of the fruit of certain varieties of persimmon (kaki) in Japan. By the curing process, which consists in keeping the fruits in vapor of alcohol or in subjecting them to slow desiccation in the sun, the tannin is changed, in contact with an oxidizing enzyme and oxygen, to a brown, tasteless substance.[16] The fruit thus acquires an agreeable taste.

Since a moderate brown color is also produced in white "nibs," free of cacao red, it follows that the brown coloration is not due exclusively to a change of cacao red. If the production of the color is due to an incomplete oxidation of the tannin, then there will be less tannin found in the cured cacao than in the fresh cacao. This agrees, indeed, with some analytical determinations of J. B. Harrison, published by Hart.[17] The fat content is assumed not to change during the curing process, and this is in all probability the case. The data compiled under this condition is as follows for Calabacillo cacao:

Analyses of Calabacillo cacao.

Constituents.	Fresh (per cent).	Cured (per cent).	Constituents.	Fresh (per cent).	Cured (per cent).
Fat	29.25	29.25	Glucose	0.99	0.60
Tannin	5.00	3.61	Hemicelluloses	5.11	3.74
Cacao red	2.95	1.39	Woody fiber	3.03	2.78
Theobromin	1.35	1.00	Protein	6.69	4.42
Caffein	.11	.03	Amido compounds	.53	2.06
Starch	3.76	3.22			

[15] K. Aso. Bul. Agr. Tokyo, Imp. Univ., 4 (1900–1902), p. 255.

[16] S. Sawamura, *ibid.*, 5 (1902–3), p. 237.

[17] Cacao, Trinidad, 1900, 2d ed., p. 100.

A part of the changes brought about by curing is probably due to the action of the living cells in the seed, before they are killed by the rising temperature. This would account for the decrease of starch, glucose, and hemicelluloses, which may be consumed by the respiration process, but the other changes are due to several enzymes. A proteolytic enzyme brings on the decrease of protein and the corresponding increase of amido compounds, while oxidizing enzymes, generally liberated from the protoplasm upon its death, cause the decrease of tannin and cacao red and their change to other compounds. The most conspicuous changes are, therefore, only possible after the death of the protoplasm, which is a desirable factor. Hence it is a mistaken idea of Zipperer that the changes are due to a germination process of the seeds. He has even attributed the rise of temperature of the fermenting pulp cacao to this process, considering it analogous to the behavior of barley on the malting floor. This error can only be explained by the fact that he never witnessed the fermentations of cacao or coffee, for germination changes are not in the least apparent.

Another result is the change of flavor. In the fresh state the seeds have a raw, bitter, and astringent flavor, while after fermentation and drying the bitter and disagreeable taste has entirely disappeared. This change is doubtless due in a certain measure to the decrease of tannin, that is, to its change by oxidation to a brown substance, as in the case of the persimmon fruits, mentioned above.[18] The flavor of the fermented beans is still far different from that of the prepared cacao product, which is produced by roasting the fermenting beans; hence a part of the taste must be due to changes caused by the heat of the roasting process.

The presence of oxidizing enzymes in the seeds of cacao can be proved by the usual reaction. Upon moistening a freshly cut section of cacao seed with tincture of guaiacum resin, just after taking the seed from the ripe fruit, a blue color is rapidly produced, first and most intensely in the chalaza of the embryo and gradually spreading over the entire seed tissue; also, the placenta shows soon an intense blue color. When a cross section through the whole fruit is moistened with guaiacum tincture, the chalaza of the embryo and the interior soft stratum of the fruit shell become rapidly and intensely blue, then follow in order the coloration of the convolutions of the cotyledons of the seed and the tissue of the hard outer shell. Finally the whole surface of the section of the seed and the exposed tissue of the testa become blue, but the slime tissue or pulp around the testa remains perfectly colorless, presenting a most striking contrast.

If the tissue of the seed is crushed with some water in a mortar, the filtered liquid will show no blue coloration on addition of guaiacum tincture, and shaking with air, while the unfiltered liquid will become

[18] The opinion of Harrison, mentioned above, that the decrease of the astringent taste is due to a hydrolysis is erroneous and would be without analogy.

blue very soon. This shows an exceptional case, namely, that the oxidase (laccase) is present in an insoluble state and perhaps held in combination with an insoluble protein.[19] Upon standing, the blue color, obtained with the unfiltered liquid, will gradually disappear, except on the surface, but on adding a few more drops of the reagent, and shaking, the intense blue color reappears. This phenomenon is due to the presence of a reducing compound in the juice.

In testing for a second oxidizing enzyme, the peroxidase, the tissue of the seed, crushed with a little water, was heated for five minutes to 75° C., and one portion of this liquid was filtered; the other not. The test with guaiacum tincture yielded no blue reaction in either liquid, proving that the oxidase was killed, while on addition of a little peroxid of hydrogen the unfiltered juice gave an intense blue reaction and the filtered juice showed only a trace. This difference proves that the peroxidase, like the oxidase, was present, but retained as an insoluble compound—an exceptional case.

Reactions with guaiacol were also tried. This substance produced no coloration when applied by itself, but in conjunction with hydrogen peroxid a red color turning to brown was soon produced in both the hard as well as the soft layer of the fruit shell. Later, in the testa and the seed in general, as well as in the slime tissue covering the testa, only a weak, reddish coloration was produced. This peroxidase reaction agrees also with that just mentioned, in so far as the slime tissue gave only an exceptionally weak reaction compared with all other parts of the fruit. The slime tissue of the coffee fruit is also poorer in oxidase and peroxidase than the other tissues.

The further generation of the characteristic aroma of cacao is of great importance. Is this process due to the action of an oxidizing enzyme or to that of a hydrolizing enzyme, and does the fermentation influence the generation of aroma only indirectly by the development of heat or directly by furnishing some compound? Or, is the roasting of the fermented cacao beans alone responsible for the aroma? The investigations thus far made do not solve this problem satisfactorily. It may be mentioned, however, that Hart[20] agrees with Chittenden,[21] who declared that after a certain stage of the fermentation "the cotyledons are found separated, and the vinous liquor of the pulp, which passes through the membranous covering, occupies this space as well as the cavities between the convolutions. * * * This it is which has so marked a physiological influence and affects its flavor, the bean being, as may be said, 'stewed in its own juice.' "

According to the laws of osmosis, some acetic acid and some alcohol from the fermenting liquor will doubtless enter through the testa and

[19] This recalls the existence of a soluble and insoluble form of catalase.

[20] Cacao, Trinidad, 1900, 2d ed., p. 38.

[21] Agr. Record, Trinidad, 2 (1890), p. 110.

come in contact with the cotyledons, which thereby may be killed, if the temperature of the fermenting mass has not already accomplished this. The reaction of the cotyledons after drying the fermented beans is acid, but whether this is wholly due to the entering acetic acid may be doubtful since the reaction is weakly acid in the fresh state. A stronger acid reaction is shown in the slime tissue.

The expression, "stewed in its own juice," used by Chittenden can hardly be admitted, since the juice of the pulp, after being entirely decomposed by yeast and bacteria, is certainly not the "own juice" of the cotyledons. Still, that author attributes to it the generation of the flavor.

The opinion of J. B. Harrison (see p. 352) that the decrease of tannin during the fermentation process stands in relation to the development of aroma (see p. 356) is certainly far from the mark, as tannin can not produce ethereal oils by any oxidation or fermenting process. Only color and taste stand in this relation to the tannin content.

Several experiments were made by the writer with an aqueous solution of 1 to 4 per cent acetic acid containing from 3 to 5 per cent of alcohol in order to imitate the composition of the fermenting pulp juice. After twenty to thirty hours' digestion of pulped cacao at 40° to 44° C., it was observed that the pulp had died and shrunk to skinny masses, partly separating in small pieces, but mostly still firmly adhering to the testa. It appears that for bringing about an easy separation of the dead pulp from the testa a bacterial enzyme is necessary, as in the case of coffee fermentation. It was further observed that the amount of acetic acid, which entered by osmosis through the testa to the cotyledons, was not sufficient to kill the oxidizing enzyme, since the freshly cut surface of these seeds rapidly turned brown on exposure to the air. On the other hand, it was observed that when the freshly cut surface of the seeds so treated was moistened with 4 per cent acetic acid no further change by oxidation took place. In this case the oxidizing enzyme was killed.

It is stated by Hart [22] that "of late years there has been a large amount of inquiry for cacao which is but slightly fermented or not fermented at all." [23] This renders it very probable that the decomposed juice of the slime tissue is not required for the generation of the aroma, as was supposed. Indeed, the true odor of cacao is faint before roasting the fermented beans. The case is, therefore, similar to that of coffee, and is different from that of tea. With tea the aroma is the result of the action of a hydrolizing enzyme, yielding the volatile tea oil, as was shown by Katayama.

That the aroma of the cacao is chiefly produced during the gentle roasting process is the opinion of the manufacturers of chocolate from

[22] Cacao, Trinidad, 1900, 2d ed., p. 33.

[23] Compare the quotation in the introductory remarks to this article.

the fermented beans. The fermentation seems, indeed, to have nothing at all to do with the production of aroma. Seeds simply dried in the sun and then gently roasted may yield an especially rich and aromatic chocolate, as Safford has also indicated. Hart says:

> No adulteration * * * is equal to the flavor of the virgin cacao, provided the essential oil has not been destroyed during the process of roasting, during which process it appears to be developed.[24]

The question now arises, which compound yields the aroma in the cautious roasting of the fermented cacao beans? It is certainly not a glucosid, for neither the testa nor the cotyledons of the beans develop anything like a cacao flavor upon being boiled for some time with dilute sulphuric acid (3 to 6 per cent). The same negative result was obtained by boiling those materials with moderately concentrated solution of caustic potash. It seems also probable that it is a certain concomitant of the fat which causes the production of the flavor, after being moderately oxidized during the drying of the beans. Only seeds in which the oxidizing enzymes have produced changes can yield the true aroma by roasting—not the fresh beans.[25]

In the manufacture of the cacao powder of commerce the fat of the cacao is removed more or less, since a suitable powder can not otherwise be obtained, but in the direct manufacture of chocolate this removal of the cacao fat can not be justified. It is claimed that cacao fat or cacao butter is difficult of digestion, but in reality cacao butter is as easily digested as cow's butter. Besides, the removal of fat also diminishes the aroma of the chocolate. In the manufacture of chocolate in Porto Rico, fermented cacao seeds are placed in a small baker's oven for about one hour until the testa have become very brittle and can be easily removed.

This roasting temperature is kept considerably lower than that required for baking bread. The cacao butter is not removed in Porto Rico, and therefore the chocolate manufactured there has an exquisitely fine aroma.

SUMMARY.

The fermentation process itself is due in the first place to yeast cells which multiply rapidly in the saccharine juice oozing from the pulped cacao and produce alcohol and carbon dioxid. In the second place bacteria participate, which develop rapidly after a certain time, and

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[24] Cacao, Trinidad, 1900, 2d ed., p. 111. These words, however, contradict his other opinion, quoted above, in regard to the influence of fermentation on aroma.

[25] Fresh beans were crushed, washed with alcohol, and extracted with ether. Neither the extracted fat nor the seed powder developed on moderate heating any flavor resembling that of cacao, only the alcoholic extract yielded thus a very faint flavor of cacao. On evaporation of the alcoholic extract another aromatic odor is noticed.

change the alcohol formed by the yeast by oxidation, either wholly or partly, into acetic acid. These processes cause a rise of temperature and the death of the cells of seed and slime tissue, whereupon the juice of the slime tissue, more or less altered, collects at the bottom of the receptacles, together with the acetic acid produced.

The chief object of the fermentation is to shrink the slime tissue or pulp attached to the testa of the seed, allowing the remnants either to be washed away, as is done in Ceylon, or dried upon the seed, forming an irregular brown film upon the testa. The advantage of thus changing the voluminous slime tissue lies in the increased facility of quickly drying the seed. In this regard there exists a close analogy to the fermentation of coffee. The loosening of the adhesion between the seed and its envelope and the hardening of this envelope (testa) are claimed as further effects of fermentation.

The fermentation has also an indirect influence on changes going on within the seed, inasmuch as by the temperature produced (40° to 50° C.) the cells of the seeds are killed, thus liberating the oxidizing enzymes, which cause the formation of the brown color, by oxidation of the tannin of the seed. This brown coloring is increased during the drying process and finally by the roasting. The taste of the raw cacao bean is not only altered by the partial oxidation of tannin during the fermentation or sun-drying of the seed, but also by products of roasting.

The action of oxidizing enzymes, as well as the final roasting process, plays a part in the development of the aroma.

THE FERMENTATION OF COFFEE.

The so-called fermentation of coffee has thus far not been investigated, and has been defined sometimes as an "alcoholic fermentation necessary to remove the saccharine matter." [26] Such saccharine matter, however, should be easily removable by simply washing with water. Upon close examination the writer concluded that the aim of the "fermentation" is the removal of a slimy stratum firmly adhering to the parchment envelope of the seeds. The removal of this is necessary because the drying of the seed envelope would otherwise be very much retarded, and because a bad flavor may finally be imparted to the seeds by the partial decay of the slimy stratum during the drying process. The process will be explained by examining the anatomical structure of the fruit. (Pl. II.)

Just below the skin of the fruit and extending between the enveloped seeds is a fibrous tissue containing a sweet juice. This pulp, together with the skin, is easily separated by mechanical means from the seeds, which are enveloped in a hard parchment. Adhering to this parchment is a stratum of very slimy cells, the slime layer.

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[26] Cf. Watt, Dictionary of the Economic Products of India. Calcutta, 1889, vol. 2, p. 476.

The preparation of coffee for market requires the following manipulations:

(1) Pulping to secure removal of the skin with the adhering tissue.

(2) Fermentation to separate the slimy layer from the parchment envelope.

(3) Washing away the loosened slime.

(4) Drying the envelope around the seeds, preparing for the necessary brittleness for the next operation.

(5) Hulling or milling, consisting in the removal of the parchment envelope, with subsequent subjection to a fan to blow away particles of parchment envelope and silver skin.

The entire fruit is often called "cherry," from the similarity of form and color. The expression "pulped coffee" signifies seeds in the parchment envelope with slimy layer. "Coffee in parchment" means the product after pulping, fermenting, and drying. The "bean" means the seeds deprived of parchment and silver skin.

Fruits of red or yellow color should be picked for pulping, as only such furnish seeds of the desired bluish-green color. Green unripened fruit containing a hard pulp and little or no sugar should be excluded, but such fruit can not be entirely avoided since some unripened seeds will drop off in gathering the ripened ones.

The fruits are well moistened with water when passing through the pulper, which easily separates the skin and fibrous layer. Attached to the pulper is a conical sieve (separator) placed in a horizontal position, which retains the fruits which have accidentally escaped pulping, and they are carried back to the pulper.[27]

In order to understand the fermentation process, it must be remembered that on the surface of all sweet fruits are a great many yeast cells and bacteria. When by the pulping the sweet juice is forced out and spread all over the separated skin, and over the pulped coffee, it is not surprising that these organisms develop rapidly. The sweet juice not only contains sugar but also some nitrogenous and mineral matters required for the development of organisms.

An examination of the skin with a high magnifying power several hours after pulping shows numerous cells of *Saccharomyces,* which in form resemble chiefly *Saccharomyces ellipsoideus* and sometimes also *S. apiculatus.*

Numerous bacteria are also present. Alcoholic fermentation can soon be detected by the vinous odor, and the fact that the fermentation pro-

[27] It has been proposed to dry the pulp and bring it into commerce as a cheap substitute for coffee. When pressed well to remove the caffein and mixed then with molasses it might serve as a food for hogs. Greshoff holds that the best application is as a manure and gives the following composition in the air-dry state: Caffein, 1.1; carbohydrates, 23.3; albumin, 7.6; cellulose, 16.1; water, 14.9; fat, 3.3; ash, 6.9.

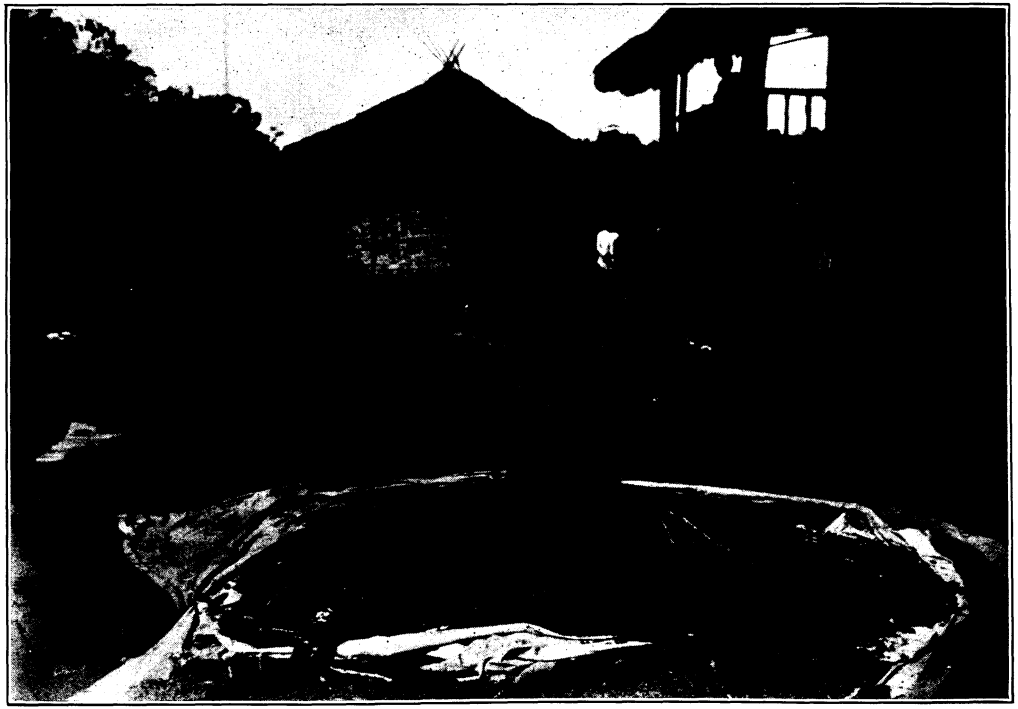

PLATE II.

duces heat explains why the temperature of such a heap of pulp rises considerably after a time. A heap of nearly 30 centimeters in height showed after sixteen hours a temperature of 41° C. at an air temperature of 26° C. Later, acetic acid is formed and the red color of the skin changed to a brownish one.

When the pulped coffee, on the other hand, is examined, a few yeast cells and bacteria are noticed on the slimy stratum after one hour, while after sixteen hours an immense increase has taken place and not only is considerable alcohol formed by the yeast cells but also acetic acid by certain bacteria. Mycoderma and the mycelium of fungi are occasionally seen. Litmus is reddened intensely and the odor of acetic acid is readily discernible. At the same time another volatile product is formed in small quantity, which modifies somewhat the acid odor.

The alcoholic fermentation of the sugar adhering to the slimy stratum, as well as the further oxidation of the alcohol to acetic acid, and finally the respiration process carried on with considerable intensity by all these organisms, cause a rise of temperature, depending upon the depth of the stratum and the temperature of the surrounding air. The heaps of pulped coffee are generally 1 to 2 feet high. In such heaps the temperature was found after fifteen to sixteen hours to range from 34° to 42° C. at an air temperature of 25° to 29° C.

The alcoholic and acetic fermentations proceeding in the heaps of pulped coffee are, however, not the most essential phenomena; the most important point is that the slimy stratum is separated from the parchment envelope. It is by no means dissolved, but merely loses its firm adhesion and is left loosely spread upon the parchment coffee so that it can easily be washed away by a current of water and the parchment coffee dried.

Neither the acetic acid nor the enzyme already present in the slime causes the separation of the slime layer, as tests have shown.

Freshly pulped coffee was kept in dilute acetic acid (about 1 per cent) at 35° to 40° C. and another portion in some water containing a few drops of ether to prevent bacterial growth. In both cases the slimy layer was found still firmly attached to the parchment after twenty-four hours. This leaves no other inference but that a peculiar enzyme dissolving the adhesive substance (a carbohydrate?) between the parchment and the slimy stratum was furnished by the bacterial growth, or, what is less probable, by the yeast cells.

The "fermentation" should not take longer in Porto Rico than fifteen to twenty hours, while in some sections of Central America, as Guatemala, it must be carried on for two days.

Undue prolongation of the fermentation must be avoided, as otherwise a brown coloration of the parchment and of the seeds is produced and the seeds further acquire a disagreeable odor—two circumstances which render the product unfit for the market.

After the fermentation and washing the parchment the coffee is readily dried, either on cement floors exposed to sun and air, or better in rotating cylinders through which warm air passes. At a certain degree of dryness the parchment becomes brittle and breaks easily in the milling process, which thus removes the parchment envelope and silver skin from the seeds. In fact, the milling must be done while the parchment is still warm.

This milling is in many cases done in London, and not in the country where the coffee is produced. Better preservation of shape and color of the bean has been observed when the latter is protected for a time by the parchment envelope. The cost of transportation is in this case a little higher, but it does not come into consideration, as from $2 to $3 more has been realized per hundredweight for coffee thus treated than for that cured in Central America.

In reviewing the so-called fermentation of coffee, the conclusion is inevitable that alcoholic and acetic fermentations are not of direct benefit, but only indirectly, inasmuch as heat is thereby produced which supports the action of a body (enzyme) furnished by the bacteria, which dissolves the adhesive substance between parchment envelope and slimy layer.

ELEMENTARY AGRICULTURE.

By H. T. EDWARDS, *Bureau of Agriculture.*

I. GENERAL AGRICULTURE.[1]

Question 1. What is agriculture?

Answer. Agriculture is the business of raising products from the land.

Question 2. What does the farmer produce?

Answer. Crops, or plants and their products; stock, or animals and their products.

Question 3. What does the farmer furnish the world?

Answer. The farmer furnishes the world with a large part of the material used for food, clothing, and shelter, besides many other minor products.

Question 4. Into what four branches may agriculture be divided?

Answer. (*a*) General agriculture, (*b*) animal industry, (*c*) forestry (*d*) horticulture.

Question 5. What does "general agriculture" include?

Answer. General agriculture includes the general management of lands and farms, and the growing of staple field crops, such as grains, fibers, sugar cane, hay, and root crops.

Question 6. What is "animal industry?"

Answer. Animal industry is the raising of animals, either for direct sale or use, or for their products.

Question 7. What three departments does animal industry include?

Answer. (*a*) Stock raising, or the growing of such animals as cattle, horses, and sheep; (*b*) dairy husbandry, or the production of milk and milk products; (*c*) poultry raising, or the growing of fowls, as chickens, turkeys, geese, and ducks.

Question 8. What is forestry?

Answer. Forestry is the growing of trees for timber and wood.

Question 9. What is horticulture?

Answer. Horticulture is the growing of fruits, garden vegetables, and ornamental plants.

Question 10. What are the most important things with which the farmer works?

Answer. (*a*) The soil, (*b*) plants, (*c*) animals.

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[1] Compiled from "The Principles of Agriculture," by L. H. Bailey, and "Elements of Agriculture," by James Bolton McBryde.

II. THE SOIL.

CONTENTS.

Question 1. What is the soil?

Answer. The soil is that part of the solid surface of the earth in which plants grow.

Question 2. What is the soil made up of?

Answer. The soil is made up of small particles of rock (*inorganic matter*) and the remains of plants and animals (*organic matter*). When the soil is in a condition to grow plants it also contains water.

Question 3. What does the soil furnish?

Answer. The soil furnishes a place in which plants can grow. It is also a great storehouse containing large quantities of plant food.

Question 4. What do we mean by "plant food?"

Answer. We all know that animals must have food if they are to live and grow. Plants, also, must have food, but plant food is quite different from the food of animals. Plants obtain their food from the soil and from the air. When a soil contains all the food that plants require we call it "rich" or "fertile." A "poor soil" is one that contains only a small amount of plant food. When a farmer wishes to grow a good crop on a poor soil, he must add more plant food to that soil. This plant food which farmers add to the soil we call "fertilizer."

Question 5. What are three important kinds of plant food?

Answer. (*a*) Nitrogen, (*b*) phosphoric acid, (*c*) potash.

Question 6. Do soils usually contain nitrogen, phosphoric acid, and potash?

Answer. Yes. Soils usually contain large amounts of these three plant foods. It has been found that in average land on farms the 8 inches of the soil on the surface of each hectare contain over 3,400 kilos of nitrogen, nearly 4,540 kilos of phosphoric acid, and over 19,000 kilos of potash. In some cases soils contain enough plant food to grow three hundred crops of rice or corn.

Question 7. Can all of this plant food be used at once?

Answer. No. Only a small amount of the plant food in soils is *available*, or in condition to be used at once.

Question 8. What do we mean by plant food in the soil that is *not available?*

Answer. Plant food in the soil that is not available is the food that is combined or "locked up" with other substances, so that the plants can not use it. Each year a part of this food becomes separated or "unlocked," so that the plants feed upon it or use it. Air, water, and the roots of plants all help to unlock this plant food.

Question 9. What is one reason why we cultivate the soil?

Answer. One reason why we cultivate the soil is so that air, water, and

the roots of plants can pass through it readily and thus make available large quantities of plant food.

Question 10. Why are the soils in forests fertile or rich?

Answer. In the forests none of the plant food is taken away. When the trees and plants die and decay, the plant food goes back to the soil.

Question 11. Why do the fields in which we grow crops become "poor"?

Answer. In cultivated fields the crops are grown and taken away. In doing this the farmer takes away from the land a large amount of plant food.

Question 12. What is the soil like?

Answer. The soil is like a great workshop or laboratory where the roots of plants, air, moisture, and many other forces are always working. We should never think of the soil as mere *dirt*.

KINDS OF SOIL.

Question 1. What are the five different kinds of soil that we usually find on farms?

Answer. (*a*) Sandy soils, (*b*) clay soils, (*c*) sandy loams, (*d*) clay loams, (*e*) humus soils.

Question 2. What is a sandy soil?

Answer. A sandy soil is one that contains a large amount of sand.

Question 3. What is a clay soil?

Answer. A clay soil is one that contains a large amount of clay. A clay soil may be recognized by its sticky character.

Question 4. What is a loam?

Answer. A loam is a soil that is a mixture of sand and clay.

Question 5. What is a sandy loam?

Answer. A sandy loam is a soil made up principally of sand and clay, but containing considerably more sand than clay.

Question 6. What is a clay loam?

Answer. A clay loam is a soil made up principally of sand and clay, but containing more clay than sand.

Question 7. What is humus soil?

Answer. A humus soil is one that contains a large amount of decaying organic matter.

Question 8. What do we mean by "light" and "heavy" soils?

Answer. When we speak of *light* and *heavy* soils we do not refer to the actual weight of the soils, but to the way they behave when cultivated.

Question 9. What is a light soil?

Answer. A light soil is one that is porous so that a plow or other implement can easily run through it. A light soil is easy to cultivate as it usually contains much sand.

Question 10. What is a heavy soil?

Answer. A heavy soil is one that is stiff and difficult to cultivate. Heavy soils contain much clay.

Question 11. What do we mean by "warm" and "cold" soils?

Answer. Soils are called *warm* and *cold* according to their power to retain the sun's heat.

Question 12. Why is the amount of heat in soils a matter of importance?

Answer. All plants for their proper development require a certain amount of heat. Seeds will not sprout until the soil has become warmed to the required temperature, and most farm crops attain their most perfect development only in warm soils.

Question 13. What conditions influence soil temperature?

Answer. (*a*) Water, (*b*) color of soil, (*c*) composition of soil, (*d*) fineness of soil.

Question 14. How does water affect the temperature of soils?

Answer. In very wet soils moisture is continually evaporating and consequently such soils are usually cold. In dry soils there is but little evaporation, and the soil through the sun's heat becomes warm. As a rule the drier the soil the greater the amount of heat absorbed.

Question 15. How does color affect the temperature of soils?

Answer. It is a well-known fact that color influences temperature, so with soils a dark soil is warmer than a light one.

Question 16. How does composition affect the temperature of soils?

Answer. As a rule sandy soils are warmer than clay soils.

Question 17. How does the fineness of the particles affect the temperature of soils?

Answer. Coarse, rocky soils suffer from extremes of temperature. In fine, well-cultivated soils the temperature is almost uniform.

TEXTURE.

Question 1. What do we mean by the "texture" of the soil?

Answer. By texture we mean the physical state or condition of the soil, such as mellow, hard, loose, compact, porous, shallow, deep, lumpy, coarse, or fine.

Question 2. What is a "mellow" soil?

Answer. A mellow soil is a soil having good texture, or one that is easily worked.

Question 3. Why is good texture important?

Answer. Good texture is important because on such a soil we get larger crops than on a soil of poor texture. In a soil that is mellow, or of good texture, the plant food is more available for the reason that such a soil holds a large amount of moisture and air and allows the free passage of the roots of plants. A mellow soil also allows a better root-hold to the plant, and furnishes a comfortable place in which the plants may grow.

Question 4. How is good texture obtained?

Answer. Good texture is obtained in two ways, (*a*) by tillage or cultivation, (*b*) by adding some material to the soil.

Question 5. How does tillage improve the texture of the soil?

Answer. Tillage improves the texture of the soil by breaking up and loosening it, so that air and moisture, can enter, and the roots of plants can move freely in the soil.

Question 6. What materials do we add to the soil to improve its texture?

Answer. Most fertilizers not only furnish plant food, but also improve the texture of the soil. Lime is often used on clay lands to make them mellow. Farm manures are usually more important in improving soil texture than in directly supplying plant food.

Question 7. What is the first thing to do to a soil?

Answer. The first thing to do to a soil is to improve its condition, or texture, by careful and thorough tillage. After the soil has been put in good condition, plant food may be supplied if it is needed. A hard, lumpy soil will not produce good crops, no matter how much plant food it may contain.

MOISTURE.

Question 1. Why do we need to have moisture in the soil?

Answer. We need to have moisture in the soil because plants can not grow without water, no matter how much plant food they may have.

Question 2. In what two ways is this water in the soil used?

Answer. (*a*) To dissolve the plant food in the soil so that it can enter the plant, (*b*) to help build up plant tissue and maintain the life of the plant.

Question 3. Do growing crops use a large amount of water?

Answer. Yes. Growing crops use a very large amount of water. The amount of water used by some common crops in their development to maturity is approximately as follows:

Crop.	Hectoliters per hectare.	Kilos of water required.
Corn	45	1,700,000
Potatoes	180	1,440,000
Oats	26	1,350,000

Question 4. What is the most common cause of the failure of crops?

Answer. The most common cause of the failure of crops is the lack of sufficient water.

Question 5. What are the three forms of water in the soil?

Answer. (*a*) Free, (*b*) capillary, (*c*) hygroscopic.

Question 6. What do we mean by "free water" in the soil?

Answer. When rain falls on the surface of the earth a part of it sinks into the soil until it reaches a hard layer of earth or rock. This water is the source of supply for springs and wells, and is known as *free water.*

Question 7. What is "capillary water"?

Answer. Capillary water is the water which adheres to the soil particles, or is in the openings between the particles. This water is not controlled by gravity, but passes from one part of the soil to another, which tends to keep the soil in uniform condition as far as moisture is concerned. The capillary water is the direct supply for plants and should be carefully provided for and saved.

Question 8. What is "hygroscopic water"?

Answer. Hygroscopic water is the water which is held firmly as a film surrounding each particle of soil. It is held so firmly that it is driven off only when the soil is exposed to a temperature of 212° F. This water is of service to plants only during the most excessive droughts.

Question 9. What are "wet lands"?

Answer. Wet lands are lands which contain too much free water. Soils which are dryish and crumbly usually contain sufficient water for the growing of plants. Lands in good condition for the growing of crops are moist, not wet.

Question 10. What is the first step toward utilizing the water of the soil?

Answer. The land should be so prepared that the rainfall may be stored. The soil should be put in such condition that it will readily absorb water.

Question 11. How does tillage enable soils to hold moisture?

Answer. Tillage enables soils to hold moisture in two ways—(*a*) by increasing the depth of the soil, (*b*) by increasing the capillary power of the soil.

Question 12. What do we mean by conservation of moisture?

Answer. Conservation of moisture means the prevention of the unnecessary waste of capillary water of the soil. It is the saving and using of moisture.

Question 13. What is the advantage of the conservation of moisture?

Answer. The advantage is to make the water which seeks to escape from the surface of the soil pass through cultivated plants.

Question 14. What is the best way to prevent loss of water from the surface of the soil by evaporation?

Answer. Frequent tillage, which loosens the soil to a depth of 5 to 8 centimeters. This dry loose soil acts like a coat or blanket on the surface of the earth. This shallow tillage should be renewed during the growing season as often as the surface of the soil becomes hard or baked.

TILLAGE.

Question 1. What is meant by tillage?

Answer. By tillage is meant the stirring of the soil for the purpose of aiding the growth of plants.

Question 2. What are two different kinds of tillage?

Answer. (*a*) Tillage which covers the entire ground, (*b*) tillage which covers only that part of the ground which lies between the plants. We practice the former before the seed is sown to prepare the land for the crop, and the latter between the rows of growing crops, to maintain the condition of the soil.

Question 3. What are other kinds of tillage?

Answer. We speak of surface tillage, shallow tillage, and deep tillage. Surface tillage is the stirring of from 2½ to 8 centimeters of the surface of the soil. Shallow tillage may extend 15 centimeters into the soil, and deep tillage is that which extends below 15 centimeters.

Question 4. What three things does tillage do?

Answer. (*a*) Tillage improves the physical condition of the soil by refining the soil and extending the feeding area for the roots; by increasing the depth of the soil so that the plants obtain a better root-hold; by making the conditions of moisture and temperature more uniform throughout the growing season. (*b*) Tillage aids in the saving of moisture by increasing the water-holding capacity of the soil, and by checking the evaporation by means of the surface-mulch. (*c*) Tillage hastens the chemical action of the soil by admitting air to the soil, and by hastening the decay of organic matter.

Question 5. What three different classes of tools are used in tilling the soil?

Answer. (*a*) Deep-working tools, (*b*) surface-working tools, (*c*) compacting tools.

Question 6. What are the principal deep-working tools?

Answer. Different kinds of plows.

Question 7. What are the principal reasons for plowing?

Answer. (*a*) To get the land in condition for planting, (*b*) to pulverize the soil, (*c*) to turn under manures, green-crops, and trash, (*d*) to deepen the soil, (*e*) to break up the hard pan, (*f*) to warm and dry the land, (*g*) to allow the weather to act on the soil.

Question 8. How deep should lands be plowed?

Answer. Under ordinary conditions lands in the Philippine Islands should be plowed 15 to 18 centimeters deep.

Question 9. What are the principal surface-working tools?

Answer. Hoes, rakes, cultivators, and harrows.

Question 10. For what purposes do we use surface-working tools?

Answer. (*a*) To make beds in which seeds can be sown and plants set out, (*b*) to cover the seeds, (*c*) to pulverize the soil, (*d*) to establish and maintain an earth-mulch, (*e*) to destroy weeds.

Question 11. How frequently should a harrow or cultivator be used?

Answer. The harrow or cultivator should be used as often as the soil becomes hard, particularly after every rain. In dry times surface tillage should usually be repeated every ten days or oftener. The drier the soil the greater the necessity for surface tillage.

Question 12. What are compacting tools?

Answer. Rollers and implements known as "plankers" or "floats."

Question 13. What are the reasons for using these tools?

Answer. (*a*) To crush clods, (*b*) to smooth the ground for the seed bed, (*c*) to hasten germination of seeds, (*d*) to make loose soils more compact and solid, (*e*) to put the land in such condition that other tools can be used.

Question 14. What is the principal objection to rolling land?

Answer. When land is rolled the surface-mulch is destroyed so that more or less soil moisture is lost by evaporation. On lands that have been rolled, surface tillage should begin as soon as the plants have appeared.

THE CASTOR-OIL PLANT.

(*Ricinus communis* L.)

By Harold Cuzner, *Bureau of Agriculture.*

The castor-oil plant (tañgan-tañgan, Tagalog), the seeds of which furnish the castor oil of commerce, is probably a native of Africa, although it is found growing wild in many tropical countries. It has been so long in cultivation that nothing is accurately known as to its original habits. Long before the Christian era it was cultivated in India and its medicinal properties were known. Its seeds have been found in ancient Egyptian tombs and its cultivation is described in the writings of the Romans. In Europe it was cultivated by Albertus Magnus, Bishop of Ratisbon, in the middle of the thirteenth century, and it was known as a garden plant in the time of Turner (1568), who mentions the oil as "oleum cicimum vel ricinum."

At the close of the same century Gerardi was familiar with this plant under the name of "ricinus," or "kili," the oil of which, he states, was used in the treatment of diseases of the skin. After this the plant seems to have fallen into complete neglect, in 1761 the seeds being rarely found in druggists' shops and the oil scarcely known. In 1764 it was again brought to notice by Peter Cavinano, a physician who had practiced for some time in the West Indies, in an article entitled, "Dissertation on the Oleum Palmae Christi, sive Oleum Ricini," in which he recommended it as a purgative.

The seeds were admitted to the London Pharmacopœia in 1788 and directions given for preparing the oil. At this period and for many years thereafter the small supply of oil required in Europe was obtained from Jamaica, but it has gradually been displaced of late years by the product of the East Indies and India, where, it is stated, 330,000 acres were devoted to the growing of the bean in 1890.

The plant is also cultivated in Africa, Italy, Central and South America, and China, and in the United States in Kansas, Oklahoma, Wisconsin, Oregon, and California. In these Islands it is not cultivated, but has grown wild in all parts of the Archipelago, and in some sections of Negros and Mindanao is reported to be taking possession of the land.

There are two forms of the plant, i. e., the large- and the small-seeded varieties. The large-seeded varieties give a rather large amount of inferior oil, which is used for lubricating, etc., while from the small-seeded varieties the medicinal oil is obtained.

Kurz states that the plant yields a white resin, but as no other writer alludes to this it may be said not to exist in any quantity worth considering.

Aside from its use as an oil plant, its principal value is as a food for the "eri" silkworm in Assan, though it is stated that paper pulp may be made from the stems and bark.

The seeds yield, on the average, from 46 to 53 per cent of oil, though there are occasional records of 60 per cent. It is a thick, viscid oil, with a specific gravity of about 0.964. The pharmaceutical product is almost colorless, while the inferior grades are of a greenish-yellow hue. The odor and taste vary from the nearly odorless and tasteless oils of the better grades to the nauseating ones of the poorer grades.

It is used for dressing leather, for lubricating, and, in India, to some extent for lighting purposes. Soap and a mordant for Turkey red dye are also made from the oil.

The oil saponifies easily with caustic soda and yields a clear, soluble product which is used in the manufacture of the cheaper grades of transparent soap. However, it is not likely to be looked upon with much favor for this purpose, as it has a tendency to become rancid in keeping, and owing to its being extremely soluble, as stated above, it is very wasteful.

The mordant for the Turkey red dye is made by treating the oil with sulphuric acid in the proportion of 4 parts of oil to 1 of acid. It should be stirred continually until thoroughly mixed, to avoid a rise in temperature; then allowed to stand twenty-four hours and washed to get rid of any fatty acids.

The exportation of oil and beans from India for the years 1885–1887 is given as follows:

Year.	Oil (gallons).	Seed (cwt.).
1885	3,207,045	476,396
1886	1,190,885	670,537
1887	2,676,012	610,893

Various investigations have been made from time to time as to the value of the cake remaining after the oil is extracted, for feed or fertilizer, but they have not proved altogether satisfactory. The Jr. Pharm. et Chin. 28 (1891), No. 12, records a case of the poisoning of two cows fed on the cake:

On the day after feeding, the temperature of one cow rose to 39.6° C., a bloody diarrhea set in, and the yield of milk fell off from 11 to 5 liters per day. The animal recovered in ten days, when a second feeding was given, with the result that one of the cows lost its four months' old fœtus, and high fever and slight diarrhea were induced. Both animals were emaciated and showed starring coats and dull eyes.

Attempts have been made to extract the poisonous principle, and some have been successful, as it has been fed in amounts varying from 1 to 3 kilos per day, mixed with chopped straw, without any bad effects being observed, but the digestive coefficient was found to be low, owing, it was thought, to the large percentage of seed coat in the meal.

While there is no doubt that the cake contains good fertilizer material, it has been found to be a more expensive source of nitrogen than cotton-seed cake, as is shown in the report of the Connecticut experiment station for 1897:

Fertilizer.	Nitrogen (per cent).	Cost of nitrogen (cents).
Cotton-seed meal	6.92–8.02	11.6
Castor cake	4.51–4.02	18.5–21.1

In actual field experiments with tobacco at the Connecticut experiment station it has also proved defective when the cost and grade of tobacco produced are considered, as will be seen from the following table:

Source of nitrogen.	Nitrogen per acre (pounds).	Yield (number leaves).				Number of pole-cured leaves per pound.		Holds fire (seconds).	
		Total.	Wrapper.						
			Long.	Short.	Per cent.	Long wrapper.	Short wrapper.	Long wrapper.	Short wrapper.
Cotton-seed meal	105	1,615	740	245	61	66	89	14	15
Castor pomace	105	1,760	803	203	60	59	84	10	15
Cotton-seed meal	175	1,673	795	276	64	61	85	12	14
Castor pomace	175	1,700	769	267	61	62	81	10	13
Cotton-seed meal	210	1,839	957	268	67	60	85	10	15
Castor pomace	210	1,863	996	271	68	60	84	10	12

During a period of five years, castor pomace produced an average of 111 pounds more tobacco than cotton-seed meal, the increase in value being $13.87. Two hundred pounds of nitrogen in the form of castor pomace costs $8.40 more than the same amount in cotton-seed meal, so that the net profit, provided the quality of the crop were the same, would have been $5.47, but this was not the case.

Another use that is sometimes made of the cake in India is for making gas to illuminate the railway stations.

CULTIVATION.

The method of cultivation followed in Madras, outlined in a circular of the Royal Botanical Gardens, Ceylon, is probably as good as any. There the land is plowed twice, after rain, and the seed dropped in the furrow and covered by the plow following. A month later, when the plants are a foot high, the land between the rows, which are a yard apart, is plowed again. The crop of beans is often followed by either peanuts or corn.

The only improvement to be suggested on this method is that the field be given clean cultivation until the plants shade the ground, and that the rows be 4, instead of 3 feet apart.

In Hawaii, according to Agricultural Press Bulletin No. 2, quite a different system is followed on some farms situated near the sea level. After preparing the land, the seeds are planted at distances of 15 feet in rows 20 feet apart, which gives 150 plants to the acre. As soon as the plants are 2 feet high the terminal bud is nipped off so as to force the production of lateral shoots, which are in turn shortened to compel the plant to branch as much as possible and keep down the height, so that the spikes may be harvested from the ground, and in order to increase the number of bearing shoots.

The plants begin to flower when from eight to nine months old, and the seed matures in about ten months. During the growing period the plants should be well cultivated. Under this system the crop is kept growing and should pay commercially for from five to seven years, but during that time must receive occasional dressings of manure.

The spikes or seed clusters should be gathered as soon as ripe, which is indicated by their beginning to dry up, split open, and throw out the seed.

After picking, the spikes may be spread on a piece of hard, smooth ground and turned occasionally so that they will dry rapidly. Where there is danger of rain while the seeds are drying, it is necessary to have a proper house with shelves made of slats on which the spikes can be placed and stirred occasionally, the openings between the slats allowing the beans to drop through into a trough below where they can be easily collected.

Profits from the crop are not generally large, as 12 bushels to the acre is considered an average yield in the United States and they sell there for from $0.75 to $1 per bushel. In Honolulu, however, the crop is stated to be from 2,500 to 3,000 pounds per year, while the maximum yield for Madras varieties is given at from 400 to 450 pounds per acre. The Honolulu report goes on to state, however, that the gross returns per acre seldom exceed $75 to $80. From this it would seem that as the plants must be grown on good land in order to produce a successful crop, it is hardly to be recommended to an already flourishing community. Though a rank, strong-growing plant, it does not necessarily deplete the soil badly, as all the plant food taken up by the leaves and stalks remains in the field, only the spikes and seeds being removed, and these spikes or their ashes may be returned to the field after the beans have been threshed out.

It has been found that 100 pounds of dry spikes yield about 55 pounds of beans and 45 pounds of pods. As to whether or not it will pay the cultivator to return the pods to the field may be judged from the amount of fertilizer contained in them. Eight hundred pounds of dry pods

contain about 13 pounds of nitrogen, 4⅓ pounds of potash, and 1½ pounds of phosphoric acid, thus more than equaling in fertilizer value the same weight of ordinary wood ashes, worth $10 per ton. One thousand pounds of beans, on the other hand, removes [illegible]5 pounds of nitrogen, 4 pounds of potash, and 14 pounds of phosphoric acid.

ENEMIES OF THE CASTOR PLANT.

The circular of the Royal Botanical Gardens of Ceylon gives two insects as being injurious to the plants, one a caterpiller, *Euproctia guttata* Wlk., which, though omniverous, shows a partiality for the leaves of the castor plant, and the other, the green fly, *Empoasca flavescens* Fabr., which was observed to be much more injurious to some varieties than others.

RATS.[1]

There is no single animal in the whole world which causes more loss and damage, and is the carrying source of more disease than the rat. It is everywhere; in every country; in fields and dwellings, in the country and in the city, living in the ground, in bushes, in trees, in rocks, absolutely everywhere.

There is no animal like it for vitality, prolificacy, persistency, and cunning. It is frugivorous, carniverous, granivorous, in fact omnivorous to an extent more than any other animal. It is not only what it eats; it destroys, spoils, and pollutes twenty times more—nothing comes amiss to it. It will carry off clothing and curtains in a house to make its own bed, and it will make its nest in the wardrobe among the best clothes. If a house is left unoccupied for a few weeks, when the owners are on a holiday, they may find their beds occupied by a nest of rats when they return. The best leather harness will be chewed through, just as readily as the binding of the best books. It is a deadly pest to the young of all animals; chickens and ducklings are never safe from it no matter where they are kept. It will eat young pigs, and even attack young lambs. Young children left to sleep alone have been badly bitten by rats; this has been a common occurence. Grain-growing countries find it their worst pest. It destroys grain when newly planted, in the ear, when stored, when shipped in a ship's hold, on the wharf, at the railway depot.

Here in Jamaica when sugar cane was our most important crop, some estates paid as much as £300 to £400 a year for rat catching alone. Now sugar estates are almost safe from its attacks, thanks to the introduction of the mongoose.

But for this and the throwing up of so many estates, rats finding their most convenient food scarce, would have swarmed everywhere doing great damage to all other crops. Rats are still our worst enemy to poultry, to corn, and especially to coffee, and cocoa crops, the latter of which is of such growing importance. Thousands of pounds are lost by damage to cocoa pods through rats now, and if we had no mongoose to check them, cocoa growers would have to spend as much as cane growers did in the past to save their crops; yet no creature is more cursed than the mongoose, simply because it takes chickens which are wandering back from the domicile in the bush. The mongoose is a timid animal, easily kept in check, readily entering traps, hunting solely by day, and falling

[1] The Hawaiian Forester and Horticulturist, March, 1908.

an easy prey to dogs. He is not responsible for more than a tenth part of the loss of young poultry that the rat is responsible for, and if it were not for him at present, poultry rearing would be much more difficult than it is.

The mongoose lives in the field and does not venture in the open, but the rat is everywhere, especially in the field, in the dwelling house, in the poultry house, working at night—stealthy, cunning, and andacious.

The scarcity of bird life is charged against the mongoose, yet those birds which build in trees are equally scarce with ground birds. We have found nests of rats in nests built by nightingales and blackbirds. Adding insult to injury, the rats, having eaten the eggs or young, occupy the nests themselves. The outcry against the mongoose is foolish, is unthinking, is hysterical.

The rat breeds three or four times a year, producing from six to twelve young, which breed again when they are four months old.

Rats are hard to trap, and are suspicious of poisoned baits. Every householder in Jamaica should wage a continual war against rats, by keeping cats, setting traps, using rat virus, and laying suitable poisons in a suitable way for safety to domestic animals. The out-of-sight trap is the most effective, but it is necessary to oil the hands with coconut oil when handling it regularly, otherwise rats get wary even of it. The ordinary iron traps should also be used, two different kinds, and whenever rats do not go into one kind use the other trap for a while, and change the kind of bait. The only safe way of laying poison outside is to use a double bamboo joint; that is, with a joint in the middle open at both ends, a bait is placed in each end so that dogs, cats, or poultry can not get at it. A different kind of bait should be used every week—that is important. Roasted salt fish, or end of bacon, toasted rind of cheese form the best baits, but ripe bananas and a crust of bread often do as well.

POISONING.

Barium carbonate.—One of the cheapest and most effective poisons for rats and mice is barium carbonate, or barytes. This mineral has the advantage of being without taste or smell and, in the small quantities used in poisoning rats and mice, is harmless to larger animals. Its action on rodents is slow but reasonably sure, and has the further advantage that the animal before dying, if exit be possible, usually leaves the premises in search of water. Its employment in houses, therefore, is rarely followed by the annoying odor which attends the use of the more virulent poisons.

The poison may be fed in the form of a dough made of one-fifth barytes and four-fifths meal, but a more convenient bait is ordinary oatmeal, with one-eighth of its bulk of barytes, mixed with water in a stiff dough; or the barytes may be spread upon bread and butter or moistened toast.

The prepared bait should be placed in rat runs, a small quantity at a time. Elsewhere strychnine may be employed with great success. Dry strychnine crystals may be inserted in small pieces of raw meat, Vienna sausage, or toasted cheese, and these placed in the rat runs, or oatmeal may be wetted with a strychnine sirup, and small quantities laid out in this way.

Strychnine sirup is prepared as follows: Dissolve a half ounce of strychnia sulphate in a pint of boiling water; add a pint of thick sugar sirup and stir thoroughly. A smaller quantity of the poison may be prepared with a proportional quantity of water. In preparing the bait it is necessary that all the oatmeal should be moistened with sirup. Wheat is the most convenient alternative bait. It should be soaked over night in a strychnine sirup.

Other poisons.—The two poisons most commonly used for rats and mice are arsenic and phosphorus, nearly all commercial preparations containing one or the other as a basis. While experiments prove that rats have great powers of resistance to arsenic, it may sometimes be used advantageously as an alternative poison. Preparations of phosphorous sold by druggists are often too weak to be effective; and homemade mixtures, when of sufficient strength, are dangerous, as rats may carry the baits into walls and crannies and thus cause fires. For these and other reasons we do not recommend preparations containing phosphorous.

POISON IN THE POULTRY HOUSE.

For poisoning rats in buildings and yards occupied by poultry, the following method is recommended:

Two wooden boxes should be used, one considerably larger than the other, and each having two or more holes in the sides large enough to admit rats. The poisoned bait should be placed on the bottom near the middle of the larger box, and the smaller box should then be inverted over it. Rats thus have free access to the bait, but fowls are excluded.

RATS IN THE PHILIPPINE ISLANDS.

Reports are occasionally received of the damage done by rats in different parts of these Islands. During the month of August, 1907, the following report was received regarding the conditions in the Province of Ambos Camarines:

> For the last two years there has been a plague of rats in this province which has been more serious than anything I ever saw with respect to the destruction of cereal crops, except drought. For this reason very little rice has been harvested here during the advent of the rats.

A large supply of arsenic was sent to this province, together with the receipts that follow for the preparation of rat poison. These receipts were furnished by the Bureau of Health, with the statement that all of

them had been successfully used, and that any one of them should be freshly prepared twice per week and the character of the bait frequently changed.

In buildings in Manila in which these poisons had been used, and which could be closed and placed in charge of a watchman, the poison was placed only at night and the unconsumed remains were gathered up in the morning. Where this was not possible placards calling attention to the placing of the poison, were liberally displayed.

RECEIPTS FOR MAKING POISONED BAITS FOR RAT DESTRUCTION.

NO. 1.

4 kilos ground rusty bacon.
3 kilos ground corn, soaked over night in a solution of sirup and water.
2 kilos finely powdered glass.
1½ kilos arsenous acid.

NO. 2.

5 kilos ground sweet potato; baked.
1 kilo cracked wheat, or flour made from same.
2 kilos old cheese.
2 kilos finely powdered glass.
1½ kilos arsenous acid.

NO. 3.

3 kilos rusty bacon.
2 kilos rolled oats.
1 kilo sirup.
2 kilos finely powdered glass.
2 kilos sweet potatoes; baked.
200 grams of triturated strychnine sulphate.

NO. 4.

2 kilos of tallow.
3 kilos of old cheese.
1 kilo of stale bread.
2 kilos of common potatoes; baked.
2 kilos of finely powdered glass.
1½ kilos arsenous acid.

NO. 5.

2 kilos of rusty ground bacon.
3 kilos of soaked rice.
1 kilo of tallow.
1 kilo of cracked corn.
1½ kilos of sirup.
2 kilos of finely powdered glass.
200 grams of triturated strychnine sulphate.

NO. 6.

Poisoned egg. This is made from the yolks of hard-boiled eggs, broken into small fragments and thoroughly mixed with triturated sulphate of strychnine in the proportion of 2 or 3 grains of strychnine to the yolk of a good-sized egg. This is an effective bait, but does not keep well.

The following report regarding the methods used for killing rats in the Province of Ambos Camarines was furnished this Bureau, December, 1907, by Mr. J. R. Hillsman:

In compliance with my promise of some time ago, the following notes are furnished in regard to poison used for killing rats in our rice fields:

At first we had no information as to the proportion of poison which should be used in bait and Formula No. 1 was tried as an experiment. This was without results so far as I know, due, without doubt, to the small percentage of poison in the bait.

Upon receipt of the arsenic sent from Manila, information was furnished by the Bureau of Agriculture as to the proportion of poison necessary, but as none of the formulas were entirely adaptable to conditions here, No. 2 was used.

This mixture (No. 2) was placed in quantities of 1 tablespoonful on the paddies about 6 feet apart, but as not many dead rats were found it was thought that the bait was not sufficiently inviting, so No. 3 was tried.

This mixture (No. 3) was rolled in balls of about 3 ounces each and placed on the paddies, 6 feet apart. These balls soon fermented and gave off a very bad odor, so No. 2 was tried again, but in balls as No. 3. These however, became so hard after being exposed to the sun for a short time that it was decided that they were not practicable; thereafter the bait was placed on the paddies as at first in quantities of 1 tablespoonful every 6 feet.

As only a small percentage of arsenic will dissolve when cooked, and none of the glass, but seems to cake at the bottom of the vessel, it was found best to make the mixture after cooking the rice. For the same reasons I was afraid that after the bait was exposed to the atmosphere much of the glass and arsenic would either dry and fall off or be washed off by the dew and rain.

Mr. Klar suggested that the poison be placed in bamboo joints along the paddies. I thought this a good idea, but did not have the time nor means to do it, and when the arsenic was received here, rats were already in the rice and it was necessary to lose no time; as it was, we lost about 30 per cent of the entire crop.

LIST OF FORMULAS TRIED.

NO. 1.

	Per cent.
Arsenic (Paris green)	10
Toasted coconut	10
Cooked rice	10

NO. 2.

	Pounds.
Arsenic	$2\frac{1}{2}$
Cooked rice	6
Powdered glass	2
Toasted coconut	2

NO. 3.

	Pounds.
Arsenic	$2\frac{1}{2}$
Cooked rice	6
Brown sugar	2
Powdered glass	2
Toasted coconut	2

After six days of continuous application of poison the rats disappeared from our farm. Although numbers of dead rats and a few dead snakes were found on the paddies, I am not prepared to state positively that their disappearance was due to poison; however, it is my opinion that such is the case. I could not persuade any of my neighbors, except "Diaca" (Chino), to employ poison on their farms, although some of them lost more than we.

NEW REGULATIONS GOVERNING CATTLE QUARANTINE IN ARGENTINA.

Consul-General Alban G. Snyder transmits from Buenos Ayres, under date of May 14, 1908, the following synopsis of a decree relative to imported cattle issued by the President of the Argentine Republic:

ARTICLE I. After the date fixed by Law No. 3959 and until new regulations on the subject have been adopted, the following regulations shall apply to imported cattle:

(*a*) Quarantine for thirty days in the port of the capital, with necessary measures for isolation and care of the animals.

(*b*) For the diagnosis of tuberculosis the application of the ophthalmic reaction in the manner proposed by the director of the bacteriological institute or in any other form the cattle division may determine.

(*c*) Injection of tuberculin on the last day but one of the quarantine, or on the day preceding it.

(*d*) Slaughter and autopsy of those animals which become infected with tuberculosis after being submitted to the treatment stated in sections (*b*) and (*c*).

(*e*) Transfer to the bacteriological institute in properly disinfected carts of those animals which develop suspicious symptoms during the quarantine under diagnosis.

(*f*) New examination of the animals in the said institute to establish the definite diagnosis and return to their owners of the sound animals and slaughter and autopsy of those having tuberculosis and recording names of their owners.

ART. II. The provisions of the decree of January 29, 1903, inconsistent with this decree are repealed.

ART. III. The cattle division shall adopt the measures of internal order necessary for fulfilling this decree and shall include its prescriptions in the new regulations for approval, previously fixing the notices referred to in Article XIII of Law No. 3959.

AGRICULTURAL CONDITIONS IN THE SUBPROVINCE OF ABRA.

By A. F. BYARS, *Bureau of Agriculture.*

Abra, now incorporated as a subprovince of Ilocos Sur, is a hilly, mountainous country and contains one river system. A little less than three-fourths of the population consist of Christians, or Ilocanos, and the other fourth are non-Christians or Tinguians, with a few Negritos. Generally speaking the people are of good disposition and moderately industrious. Beside farming and fishing, the Ilocano women do considerable weaving on hand looms. They make cloth for most of their own clothing, and sell the Tinguians what little they need; but, aside from the few manufactures on a small scale, these people are almost entirely dependent upon farming for a livelihood.

Abra appears to be very thinly populated, owing to the fact that about all of the people live in towns or barrios, and everything is carried on in a small way—most of the farms are about as large as a garden in the United States, and produce is carried to market on the heads of women. As a matter of fact, however, this section is 72 per cent more densely populated than is the United States as a whole, there being forty-four persons to the square mile.

The younger people seem ready and anxious to learn new and improved methods of farming, especially those who have attended American schools. It is very difficult to get the older people to make any change in the methods to which they have become accustomed; an example of this is the common practice of cutting rings around the base of coconut trees, the reason for which I have never been able to ascertain.

TRANSPORTATION.

Aside from the Abra River and its tributaries, Abra may be said to have no transportation facilities worthy of mention. All other transportation is either by carabao sleds or by packers. In the whole of Abra there is not a single stretch of road 3 miles in length that is passable for wheeled vehicles—the longest road being from Bangued to its boat landing on the river. Transportation on the river is very cheap, and even horses and carabaos are sent down the river on bamboo rafts. Numerous

rafts of corn and other products pass down the river every day. All except two or three of the towns of any importance lie either in the valley of the Abra River or in those of its tributaries. This river is the very life of the province; it not only furnishes the princpial means of transportation, but also hundreds of people live on the fish caught from its waters.

IRRIGATION.

The irrigation facilities of the Abra River which have thus far been utilized are as nothing compared with those that have not as yet been developed. There are many places in the river where dams could be erected at a comparatively small cost. It is believed that the largely increased productivity of the area irrigated would justify considerable expenditure in the development of irrigation possibilities in Abra.

SOIL CONDITIONS.

The soil whch is usually very deep, rich, and of a chocolate, clay-loam type, is apparently of volcanic origin, though there is a considerable admixture of limestone. These soils are suitable for the successful production of a large number of different crops.

CROPS.

Rice, corn, sugar cane, and tobacco, in the order named, are the most important crops. A large number of vegetables, such as egg plant, tomatoes, beans, sweet potatoes, native varieties of squashes and turnips, and cucumbers, and numerous fruits, such as bananas, mangoes, papayas, pineapples, native cherries (lumboy), and plums (ciruela), anonas, and santols, can be found in nearly all parts of the province.

Corn grows almost anywhere, is planted any season, and does comparatively well. Special opportunities are afforded for the development of the cacao industry. Pineapples do especially well. Considerable profit might be derived with very little expenditure by growing kapok along the fence rows and hedges, and thousands of tons of maguey could be grown upon the poor, rocky soils, and rafted down the Abra River to the coast.

A considerable quantity of tobacco is grown in Abra. At the present time this tobacco is being gathered, and cured by hanging in the houses in the shade, but most of it is of a coarse, inferior quality. The people do not seem to understand the advantages of topping tobacco, and it is usually planted much too closely. The bud worm and large tobacco worm also do considerable damage.

A comparatively large quantity of very good sweet potatoes are grown in this province.

As a whole Abra produces mostly food stuffs and live stock and has no special market crop. It is believed that cacao might be of importance if more attention were given to its cultivation.

PLATE III.

CACAO.

The following observations on the cacao tree were made in the towns of Bangued, La Paz, Doloris, Bucay, and San Jose:

Like most plants grown more or less in the shade, the cacao tree has many insect enemies. The insect which causes the most damage and which kills the largest number of trees is a grub or borer, but there are several others which sometimes cause the death of the tree and frequently loss of its fruit. Usually when you find a tree attacked by a borer you will find these other insects close in its wake.

One of the insects which is the most numerous is a small *Coleoptera* about the size and form of a cotton-boll weevil. This insect always makes its entrance in the snag or butt of some dead limb, or any wound that causes a small decayed area, but after it gets a foothold it feeds on both the live and dead wood.

In similar places one frequently finds numerous tiny plant lice about the size of a pinhead. These insects, however, seem to prefer a fresh wound on the trunk of a tree and are often found in the tunnel of the borer when it comes near the surface and the bark caves in and splits.

Ants also do considerable damage and are one of the first insects to enter a wound of any kind. Whole colonies of them may be found in the dead butt of some limb that has been cut or broken off.

The insect that probably does more than all the others toward destroying the fruit is a little white sucking insect, about one-half the size of an English pea, which attacks the tender buds and fruit stalks as soon as they appear. This insect has the widest range of food plants of any I have yet observed, as it attacks the tender portions or fruit of almost every species of plants. It apparently moves very little, if any, after it finds a suitable spot to feed upon. At these points it surrounds itself with a halo of white hair-like antennæ and a white scale which it casts off its body. In the case of the cacao this insect sucks the juices from the young fruit stalks and buds until they die and drop off. Owing to the fact that this is a sucking insect, it can not be destroyed by means of ordinary insecticides, and if a "contact" poison such as kerosene emulsion is used, care must be taken not to have it strong enough to kill the young tender shoots of the cacao. The destruction of this insect is a serious proposition, and about the only way to get rid of it is by hand picking.

I have noticed trees in a few of the cacao orchards dying from what appeared to be a blight or fungous disease of some kind. In some cases the symptoms are similar to those of pear blight, the disease first appearing on the ends of the branches. I have advised pruning of these branches several inches below the affected part and burning; and in some cases of badly infected trees digging up by the roots and burning.

A wound of any kind affords an admirable place for the entrance of

fungous diseases. I have frequently noticed minute spore stalks covering some of the dying branches and those sunken places in the bark over a borer's tunnel. The heads of these spore stalks can be seen with the naked eye and are yellowish-red in color.

The most common type of soil found in Abra, a chocolate-colored clay loam, is well suited to the growth of the cacao and where the trees are given care and attention, this industry is a very profitable one. With soil and climatic conditions favorable, the only things to be overcome are the attacks of insects and fungous diseases. Promptness in pruning dead or dying branches, covering all of the wounds with pine tar, coal tar, or some other insect repellant, and occasional spraying with a fungicide, would go far toward overcoming these difficulties.

CACAO AT BUCAY.

In this section of Abra there are quite a number of groves of cacao. They are usually planted around houses and do best when given considerable shade. Some of the natives take very good care of the trees, water them frequently, and get good yields; others do little more than plant the trees and gather what little fruit is produced. The season for gathering the heaviest crop has just passed, and one can see piles of husks from which the beans have been extracted. The beans are packed in baskets and are carried to the markets in Vigan, where they are sold. It is claimed that the annual yield of Bucay is about 50 cavans.

An American living in Bucay has a young grove two years old containing 3,000 cacao trees which will begin bearing this year. He is now building a dam 40 feet in diameter of limestone and cement, in a narrow gorge across the river from Bucay, for the purpose of irrigating his cacao trees and other crops. A small gasoline engine will also be installed to pump water for irrigating purposes. It seems probable that this investment in cacao will be a paying one.

There is no reason why cacao should not be one of the chief money crops of this section. The soil and climatic conditions are suitable, and all that is required is plenty of water, some shade, and a little care. Under these conditions cacao is a comparatively certain crop and there probably will always be a good demand for this product.

CORN.

Corn does well in nearly all parts of this province, and at the present time more land is devoted to this crop than to all other crops combined. It is stated that the present corn crop is larger and better than usual, this being due to the shortage of last year's rice crop. It has been noticed that corn does exceptionally well on rice paddies when planted during the dry season, and there seems to be no reason why all of the rice fields should not be planted to corn as soon as the rice is harvested. The corn

PLATE IV.

crop could certainly be raised with less labor and expense, and its food value per hectare is more than rice; furthermore, the corn crop would not interfere in any way with the regular crop of rice during the wet season.

Rice has been and probably will continue to be the chief food of the natives, but a partial supplanting of this crop by corn will add a great deal to the prosperity of the country. Corn can be planted, cultivated, and harvested more easily than rice, and without any added expense of irrigation. Corn is almost certain to produce a crop not much less than the average and in this province it can be planted at almost any time of the year.

Not only can Abra be made to yield large crops of corn, but also this crop can be easily and cheaply transported to the market at Vigan by means of bamboo rafts down the Abra River. A considerable amount is now being marketed in this way, and I have seen many of these rafts loaded with nothing but corn.

The quality of the Abra corn compares very favorably with that found in the markets in Manila. It is, I think, larger in ear and most of the ears are fully developed. The size and quality could be considerably improved by selection of seed, and also by allowing the ears to fully develop upon the stalks before gathering. The corn is usually gathered before it is fully matured, for the purpose of securing a better forage for the stock.

LIVE STOCK.

At the present time stock raising is the chief industry, but it is by no means what intelligent breeding and careful handling of animals might make it. Little thought is given to the animals which shall be used for breeding purposes, especially among horses. The mares are turned out and allowed to run with any kind of stallion, consequently the horses average small in size.

Crossing the native mares with an American stallion would improve the quality of the offspring.

Abra's grassy hillsides and numerous mountain streams furnish a bountiful supply of good feed and water, making it in many respects an ideal stock-raising country. With the possibilities for the production of corn which can be supplemented with the native grasses, this province offers fine inducements to the stock raiser.

This industry is, at present, the chief source for ready money. When a native specially needs money for any purpose he sells a horse or a carabao. Crops are fenced in and the animals are allowed the free run of the country. In some sections, especially in the wild, mountainous parts, horses, carabaos, and cattle are seldom caught, and some of them become almost or entirely wild. These animals up in the hills and mountains stay in a fine condition all the year round. The finest stock

I have seen in the province was along the tributary of the Abra River, near Salapadan—they were half wild and a very few of them have ever been worked. It is claimed that some of the natives (Tinguians) own as many as one hundred carabaos, half of which are never marked or registered. No matter how dry the season may be, there is seldom a week passes without some rain falling in the mountainous section of Abra, and the grass stays fresh the year round.

As a whole I think the cattle are pretty well suited to existing conditions in this province. They are very hardy and strong, and stand the climate well, though none of them are milkers. In many respects the native ox is better than the carabao as a work animal and is a much faster traveler.

The size of some of the hogs in Abra compares favorably with that of many found in the United States. I have seen some very fine specimens in Bangued, though it is probable that there is not a pure-bred animal of any kind in the province.

There are a large number of goats in Abra. They are apparently very healthy (I have not noticed a single sick one) and from the size of the udder of the female it is quite evident that by crossing with some milk-producing breed, such as the Maltese, a native milch goat could be produced. Something might be done toward producing a long-haired breed, though the climate is rather warm for that. There are also a few sheep in Abra, but their wool is short and no use made of it.

No other animal in Abra could be so readily improved by intelligent breeding as the horse. At present practically no attention is given to breeding—all the best males are sold off the ranges, and the mares with the inferior males, crippled or otherwise unsalable, are kept to do the breeding. Great improvement in the quality of Abra horses could be brought about by the use of selected native stallions for breeding purposes. Of course the use of American stallions might lessen the stamina of the offspring, but this defect would be greatly overbalanced by increased size and strength. To increase the size of the horses would mean a great increase in the wealth of the province.

The development of Abra is yet in its infancy, considering its natural resources. As first steps in further development the farmers need instruction in modern agricultural methods, a better class of live stock, and good roads.

CROPS PLANTED AND HARVESTED AND CONDITION OF SAME TAKEN FROM MONTHLY CROP REPORTS FOR THE MONTH OF JULY, 1908.

[RICE.—Attention is invited to the fact that this article should be understood as being in the unhulled state.]

Province and crop.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Albay (reports from 13 towns):	*Hectares.*		*Hectares.*		
Rice	855	Good	15	155	Cavans.
Abacá	229	do	3,125	9,926	Piculs.
Coconuts		do		638,900	Nuts.
Corn	25	Fair	115	1,630	Cavans.
Ambos Camarines (reports from 26 towns):					
Rice	500	Good	2		
Abacá	100	do	3,242	10,516	Piculs.
Coconuts		do		188,750	Nuts.
Corn	92	do	376	6,115	Cavans.
Antique (reports from 8 towns):					
Rice	7,627	do			
Abacá	300	do	300	200	Piculs.
Coconuts		do		138,111	Nuts.
Corn	200	do	5,815	11,620	Cavans.
Bataan (reports from 6 towns):					
Rice	360	do			
Corn		do	50	300	Do.
Coconuts		Fair			
Sugar cane		Good			
Batangas (reports from 13 towns):					
Rice	2,100	do			
Sugar cane	15	do			
Abacá	26	do	21	115	Piculs.
Corn	20	Fair	155	2,070	Cavans.
Benguet (reports from 11 towns):					
Coffee		do	2		
Sugar cane		Good		12	Piculs.
Corn		Fair	21	123	Cavans.
Rice	17	Good	210	1,029	Do.
Bohol (reports from 28 towns):					
Rice	1,845	do			
Coconuts		do		1,816,194	Nuts.
Abacá	12	do	56	269	Piculs.
Corn	555	Fair	62	645	Cavans.
Bulacan (reports from 13 towns):					
Rice	17,422	Good	1,000		
Corn	85	Fair	120	2,050	Do.
Sugar cane	30	do			
Tobacco	75	do			
Cagayan (reports from 14 towns):					
Rice	527	Good			
Coconuts		do		70,000	Nuts.
Corn	500	Fair	261	2,530	Cavans.
Sugar cane	128	do			
Capiz (reports from 15 towns):					
Rice	14,017	Good	50	1,100	Do.
Abacá	152	do	201	1,596	Piculs.
Coconuts		do		624,550	Nuts.
Corn	4	do	791	3,364	Cavans.
Cavite (reports from 10 towns):					
Rice	100	do	1,145	11,000	Do.
Abacá	55	do	5	110	Piculs.
Sugar cane		Fair			
Corn		do	45	8	Cavans.

Crops planted and harvested and condition of same taken from monthly crop reports for the month of July, 1908—Continued.

Province and crop.	Planted during month.	Condition.	Harvested during month. Area.	Quantity.	Unit.
Cebu (reports from 23 towns):	*Hectares.*		*Hectares.*		
Coconuts		Good		226,281	Nuts.
Corn	469	Fair	95	1,374	Cavans.
Maguey	89	Good	164	265	Piculs.
Tobacco		do	63	7,433	Quintals.
Ilocos Norte (reports from 7 towns):					
Rice	4,918	Fair			
Sugar cane		Good			
Corn	20	do	18	546	Cavans.
Maguey	473	do			
Ilocos Sur (reports from 19 towns):					
Rice	12,817	do			
Maguey	90	do	20	20	Piculs.
Sugar cane	20	do			
Corn	233	Fair	1,689	4,392	Cavans.
Iloilo (reports from 14 towns):					
Rice	20,100	Good			
Sugar cane	300	do			
Coconuts		do		77,200	Nuts.
Corn	1,032	Fair	249	2,674	Cavans.
Isabela (reports from 4 towns):					
Rice	65	Good			
Sugar cane	2	Fair			
Corn	698	do	504		
La Laguna (reports from 17 towns):					
Rice	6,336	Good	1,214	26,425	Do.
Corn	111	do	114	5,046	Do.
Coconuts		do		5,155,129	Nuts.
Abacá	19	do	384	425	Piculs.
La Union (reports from 6 towns):					
Rice	2,280	do			
Coconuts		do		4,500	Nuts.
Sugar cane	2	do			
Corn	300	do	579	2,883	Cavans.
Lepanto-Bontoc (reports from 15 towns):					
Rice	7,863	do	6,783	16,126	Do.
Coconuts		do			
Corn	30	Fair	119	1,736	Do.
Sugar cane	4	Good	4	10	Piculs.
Leyte (reports from 18 towns):					
Abacá	199	do	1,881	12,554	Do.
Coconuts		do		977,387	Nuts.
Corn	20	Fair	1,135	16,700	Cavans.
Sugar cane	13	Good	166	1,245	Piculs.
Mindoro (reports from 3 towns):					
Rice	336	do			
Coconuts		do		7,000	Nuts.
Abacá	14	Excellent	29	29	Piculs.
Sugar cane	50	do	3	3	Do.
Misamis (reports from 3 towns):					
Rice	400	Fair			
Abacá		do	114	1,216	Do.
Coconuts		do		721,538	Nuts.
Sugar cane		do	6	150	Piculs.
Moro (reports from 5 towns):					
Rice	69	Good	85	2,000	Cavans.
Abacá	10	do	70	981	Piculs.
Coconuts		do		107,803	Nuts.
Corn	40	do	20	600	Cavans.
Nueva Ecija (reports from 17 towns):					
Rice	32,328	do			
Coconuts		do		5,000	Nuts.
Sugar cane		do			
Corn	57	do	409	4,297	Cavans.
Nueva Vizcaya (reports from 4 towns):					
Rice		do			
Coconuts		do			
Sugar cane		do			
Corn		do			
Occidental Negros (reports from 14 towns):					
Rice	3,151	do			
Coconuts		do		40,200	Nuts.
Sugar cane		do	1,300	2,200	Piculs.
Corn	560	do	636	9,415	Cavans.

Crops planted and harvested and condition of same taken from monthly crop reports for the month of July, 1908—Continued.

Province and crop.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Oriental Negros (reports from 11 towns):	*Hectares.*		*Hectares.*		
Abacá	153	do	493	965	Piculs.
Coconuts		do		428,101	Nuts.
Corn	1,360	Fair	26	636	Cavans.
Sugar cane		do		2,600	Piculs.
Pampanga (reports from 10 towns):					
Rice	14,036	Good			
Sugar cane	750	do			
Corn	150	Fair	780	14,720	Cavans.
Pangasinan (reports from 30 towns):					
Rice	49,720	Good			
Coconuts		do		164,220	Nuts.
Sugar cane	92	do	15	10	Piculs.
Corn	206	do	2,640	39,580	Cavans.
Rizal (reports from 11 towns):					
Rice	2,307	do			
Sugar cane	50	do			
Maguey		do			
Corn		do	123	544	Do.
Samar (reports from 21 towns):					
Rice	633	do			
Abacá	478	do	2,178	6,873	Piculs.
Coconuts		do		1,183,591	Nuts.
Corn	111	do	423	1,008	Cavans.
Sorsogon (reports from 15 towns):					
Abacá	2,528	do	5,557	8,365	Piculs.
Coconuts		do		67,856	Nuts.
Sugar cane	13	Fair	304	20	Piculs.
Corn	725	Good	65	165	Cavans.
Surigao (reports from 2 towns):					
Abacá	26	do	107	800	Piculs.
Coconuts		do		26,000	Nuts.
Tobacco	2	do		20	Quintals.
Corn	50	do			
Tarlac (reports from 9 towns):					
Rice	11,596	do			
Corn	245	Fair	508	2,170	Cavans.
Coconuts		do			
Sugar cane		Good			
Tayabas (reports from 16 towns):					
Rice	3,320	do			
Abacá	216	do	213	439	Piculs.
Coconuts		do		2,030,498	Nuts.
Corn	25	Fair			
Zambales (reports from 8 towns):					
Rice	6,930	Good			
Coconuts		do			
Sugar cane		do			
Corn		do	49	90	Cavans.

RANGE OF PRICES OF PHILIPPINE AGRICULTURAL PRODUCTS.

Highest, lowest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the month of July, 1908.

Province.	Rice, unhulled, per cavan.			Abacá, per picul.			Copra, per picul.		
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Agusan	₱4.00	₱3.00	₱3.50	₱8.00	₱7.00	₱7.50	--------	--------	--------
Albay	3.62	2.00	2.81	9.50	5.50	7.50	₱7.00	₱5.50	₱6.25
Ambos Camarines	3.50	2.00	2.75	13.00	4.00	8.50	8.00	2.00	5.00
Antique	3.12	2.00	2.56	15.00	6.60	10.80	9.00	5.50	7.25
Bataan	3.00	2.00	2.50	--------	--------	--------	--------	--------	--------
Batangas	3.50	2.00	2.75	14.00	12.00	13.00	4.50	4.50	4.50
Benguet	4.00	3.00	3.50	--------	--------	--------	--------	--------	--------
Bohol	3.75	2.00	2.87	15.00	5.50	10.25	7.50	5.00	6.25
Bulacan	3.00	2.40	2.70	--------	--------	--------	--------	--------	--------
Cagayan	3.75	2.50	3.12	--------	--------	--------	6.00	5.50	5.75
Capiz	3.75	2.00	2.87	16.00	10.00	13.00	6.50	4.00	5.25
Cavite	3.25	2.00	2.62	16.50	13.00	14.75	--------	--------	--------
Cebu	3.25	2.00	2.62	14.50	10.00	12.25	8.00	5.00	6.50
Ilocos Norte	3.50	3.00	3.25	--------	--------	--------	--------	--------	--------
Ilocos Sur	3.90	2.75	3.32	--------	--------	--------	6.00	6.00	6.00
Iloilo	3.20	2.25	2.72	15.20	18.00	16.60	6.50	3.50	5.00
Isabela	3.50	3.50	3.50	--------	--------	--------	--------	--------	--------
La Laguna	3.12	2.00	2.56	16.00	7.00	11.50	7.20	5.00	6.10
La Union	4.00	3.90	3.95	--------	--------	--------	8.00	6.00	7.00
Lepanto-Bontoc	4.00	2.50	3.25	--------	--------	--------	3.00	3.00	3.00
Leyte	3.50	2.50	3.00	15.00	6.00	10.50	6.50	4.00	5.25
Mindoro	3.00	2.15	2.57	15.00	12.00	13.50	5.00	4.50	4.75
Misamis	3.75	3.00	3.37	7.75	5.50	6.62	6.75	6.00	6.37
Moro	2.50	2.00	2.25	13.50	6.05	9.77	6.50	6.00	6.25
Nueva Ecija	2.50	1.80	2.15	--------	--------	--------	--------	--------	--------
Nueva Vizcaya	3.12	3.12	3.12	--------	--------	--------	--------	--------	--------
Occidental Negros	3.25	2.50	2.87	14.40	12.00	13.20	7.00	5.00	6.00
Oriental Negros	3.50	2.50	3.00	15.60	6.50	11.05	7.50	2.50	5.00
Palawan	2.60	2.00	2.30	--------	--------	--------	5.00	5.00	5.00
Pampanga	3.00	2.25	2.62	--------	--------	--------	--------	--------	--------
Pangasinan	3.75	2.00	2.87	--------	--------	--------	10.00	3.00	6.50
Rizal	2.75	2.50	2.62	--------	--------	--------	--------	--------	--------
Samar	3.00	2.00	2.50	15.00	8.00	11.50	7.00	5.50	6.25
Sorsogon	3.25	2.00	2.62	14.00	5.50	9.75	6.00	5.00	5.50
Surigao	2.50	2.50	2.50	12.00	11.00	11.50	6.50	5.00	5.75
Tarlac	3.12	2.00	2.56	--------	--------	--------	--------	--------	--------
Tayabas	3.00	2.00	2.50	16.00	4.00	10.00	6.00	4.00	5.00
Zambales	3.00	2.50	2.75	--------	--------	--------	--------	--------	--------

Highest, lowest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the month of July, 1908—Continued.

Province.	Sugar, per picul.			Tobacco, per quintal.			Corn, per cavan.		
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Agusan									
Albay	₱8.00	₱5.50	₱6.75	₱20.00	₱20.00	₱20.00	₱5.00	₱1.50	₱3.25
Ambos Camarines	8.00	5.00	6.50				4.00	1.50	2.75
Antique	2.00	2.00	2.00	35.00	6.00	20.50	2.50	1.50	2.00
Bataan	4.50	3.50	4.00				1.50	1.50	1.50
Batangas	4.50	3.10	3.80	12.00	12.00	12.00	3.00	1.30	2.15
Benguet	5.00	3.00	4.00				5.00	3.00	4.00
Bohol	5.00	3.00	4.00	28.00	3.00	15.50	4.00	2.00	3.00
Bulacan	6.50	4.00	5.25	12.00	12.00	12.00	3.00	2.00	2.50
Cagayan	8.50	6.00	7.25	15.00	6.00	10.50	3.50	1.75	2.62
Capiz	5.00	5.00	5.00	15.00	10.00	12.50	1.80	1.20	1.50
Cavite	5.00	2.50	3.75				3.50	1.50	2.50
Cebu	8.00	2.50	5.25	25.00	5.00	15.00	4.00	2.00	3.00
Ilocos Norte	5.00	2.00	3.50	19.00	8.00	13.50	4.00	2.80	3.40
Ilocos Sur	5.00	3.50	4.25	30.00	2.50	16.25	5.00	2.00	3.50
Iloilo	6.00	4.00	5.00	30.00	5.00	17.50	3.20	2.00	2.60
Isabela	5.00	5.00	5.00	12.00	12.00	12.00	3.00	3.00	3.00
La Laguna	7.25	3.50	5.37				5.00	2.00	3.50
La Union	4.50	4.50	4.50	9.00	1.00	5.00	4.50	2.50	3.50
Lepanto-Bontoc	6.25	2.50	4.37	8.00	2.50	5.25	5.00	1.50	3.25
Leyte	7.00	2.00	4.50	32.00	10.00	21.00	3.50	2.00	2.75
Mindoro	5.00	5.00	5.00				3.50	2.00	2.75
Misamis	4.25	4.25	4.25	20.00	12.00	16.00	3.75	3.50	3.62
Moro	5.25	5.25	5.25				2.50	2.50	2.50
Nueva Ecija	8.00	7.00	7.50	32.00	4.00	18.00	3.00	1.25	2.12
Nueva Vizcaya				32.00	20.00	26.00	2.00	1.50	1.75
Occidental Negros	5.00	3.75	4.37	30.00	3.00	16.50	3.00	1.80	2.40
Oriental Negros	5.00	3.50	4.25	25.00	6.70	15.85	5.00	2.40	3.70
Palawan				20.00	20.00	20.00			
Pampanga	7.00	3.40	5.20				2.50	1.50	2.00
Pangasinan	7.00	2.50	4.75	30.00	2.00	16.00	4.00	1.00	2.50
Rizal	5.00	4.50	4.75				5.00	1.50	3.25
Samar	6.50	3.00	4.75	28.00	10.00	19.00	3.00	1.50	2.25
Sorsogon	4.00	3.00	3.50	12.50	8.00	10.25	5.00	1.75	3.37
Surigao							2.00	2.00	2.00
Tarlac	5.00	3.40	4.20	7.00	6.55	6.77	3.50	1.40	2.45
Tayabas	6.25	4.00	5.12	8.00	7.00	7.50	3.00	1.00	2.00
Zambales	6.25	6.25	6.25				5.00	3.25	4.12

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VOL. I OCTOBER, 1908 No. 10

The Philippine Agricultural Review

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Bureau of Agriculture.

SEED AND PLANT DISTRIBUTION.

MAGUEY PLANTS.

Maguey plants will be distributed free of charge to parties requesting them, for their own use, as follows:

200 Hawaiian sucker plants, or
400 native sucker plants.

Parties wishing larger quantities will be required to pay for them at the following rates:

	Per 1,000.
Hawaiian sucker plants	₱10.00
Native sucker plants	6.00

Parties ordering plants not on the free list should send post-office money order for the amount of purchase.

Literature on the subject of maguey growing in the Philippine Islands can be secured from the Bureau of Agriculture.

KAPOK.

The Bureau of Agriculture now has a large supply of *Kapok* seedlings, which will be distributed without charge to persons making application for the same. Applications should be made at once so that the trees can be set out before the close of the present rainy season.

GUINEA GRASS.

Roots of this valuable forage plant will be furnished upon application. Guinea grass requires a rather high temperature, plenty of sunshine, and a soil that while moist is not too wet. Unless planted in a well-drained soil, the roots of this grass should not be set out until near the end of the rainy season.

MULBERRY.

A limited supply of mulberry cuttings can now be furnished to persons interested in the growing of silkworms.

Applicants for seeds or plants are requested to write name and address clearly, and to give full shipping directions for any material that can not be sent by mail. All communications should be addressed to the Director, Bureau of Agriculture, Manila, Philippine Islands.

G. E. Nesom, *Director of Agriculture.*

PLATE I.

THE PHILIPPINE

Agricultural Review

VOL. I OCTOBER, 1908 No. 10

CONTENTS AND ILLUSTRATIONS.

CONTENTS.

ILLUSTRATIONS.

EDITORIAL.

AGRICULTURAL CONDITIONS IN JAVA.

The Bureau of Agriculture has had but little advantage of actual exploration in the foreign countries by its own employees.

When Mr. R. L. Clute, now an agricultural inspector in this Bureau, was a teacher of agriculture in the Bureau of Education, he visited the Island of Java to make a study of the people and their industries. The results of his observations were put into writing and filed with the Director of Agriculture. A condensation of his observations on questions of agriculture is presented in this number. It will be noted that

the crops grown and the systems used in Java are very similar to those in many parts of the Philippines. The account of the cultivation of cinchona is very interesting and pertains to a crop that is practically unknown in the Philippines.

THE PHILIPPINE VETERINARY MEDICAL ASSOCIATION.

The greatest agricultural problem with which the Government has had to contend has been the suppression of infective animal diseases. Their continued presence has constituted such a serious menace to the future of agriculture that success has depended on their suppression.

It has been the effort of the REVIEW to give its readers a full account of these diseases, the methods necessary in their eradication, and such technical information as would be useful in dealing with them when outbreaks occur.

We begin this month with the first installment of the Proceedings of the Philippine Veterinary Medical Association, held in the city of Manila September 28, 29, and 30. It is intended that the remainder of these proceedings shall be published complete in the November and December numbers of the REVIEW. These proceedings embody the wisdom of the men who have made a special study of this question and who are actually engaged in one way or another in the solution of the problem.

The two papers presented in this number are among the most interesting that were read during this meeting. Neither of them is by a veterinarian, but they deal with subjects that are of vital interest to the work of Government veterinarians in these Islands.

The circular by the Executive Secretary which follows these proceedings is an executive document resulting from the discussion of the legal phases of controlling animal diseases in the Islands, but it is not actually a part of the proceedings of this meeting.

The only successful means by which we will ever eradicate infective animal diseases in this Archipelago is by educating the people of the Islands in the importance of the diseases, proper sanitation, quarantine measures, and even the destruction of animals infected with extremely dangerous diseases.

IRRIGATION.

We are reproducing in this number an article published in the "Journal for the Department of Agriculture of Victoria" on irrigation methods. This is a subject which has received substantial recognition in the Philippines. An appropriation of a million pesos to be expended in the construction and maintenance of irrigation systems was made by the last Legislature.

It is understood that active steps are now being taken by the Bureau of Public Works to expend this money in the direction required by the law making the appropriation, but that plans have not yet fully matured for the disposal of the entire amount.

In the early history of the Bureau of Agriculture extensive investigations of soils with reference to adaptability to crops and irrigation were undertaken, but unfortunately have not been pursued during the last three years. Since the transfer of the veterinary division to this Bureau, the control of infectious animal diseases has been considered our most important work. A large part of the time of its employees and the money available for expenditure by this Bureau have been devoted to this undertaking.

Now that conditions with reference to animal diseases show marked evidences of improvement, it is proposed to take up again the study of soils along the lines followed by the United States Department of Agriculture with a view to accumulating a valuable store of information on this subject.

OUR CIRCULATION.

The PHILIPPINE AGRICULTURAL REVIEW has proven to be a much larger enterprise than we at first supposed it would become. Our edition has now reached 6,000 Spanish and 4,000 English, or a total of 10,000 copies. This number is too small to meet the demands of the applicants, but it is all we can publish on account of limited appropriations. It is hoped that some arrangement can be made to successfully meet all the demands without distributing the REVIEW in large numbers to persons who can not make good use of it.

An attempt will be made to revise our mailing list at the beginning of the year 1909. All of our readers in the Philippines are requested to assist the management in getting the REVIEW into the hands of persons who can read and appreciate it, and avoid sending it to others who can not use it.

AGRICULTURAL CONDITIONS IN JAVA.

By R. L. CLUTE, *Bureau of Agriculture.*

During the months of April and May, 1907, I visited Java for the purpose of studying agricultural conditions in that country. These investigations covered a period of thirty-two days, in the course of which a number of the leading plantations in different parts of the island were visited. The following paper is a brief report of the conditions found on three plantations.

COFFEE AND CACAO.

Pare is the distributing center for a group of coffee and cacao estates which extend along the sloping sides of the recently extinct Kluet Volcano. In the palmy days of coffee culture in Java, before the price dropped from ₱56 to ₱24 per picul, these plantations were prosperous, but the sudden fall in prices reduced the profits to such a degree that the owners were willing to sell very cheap.

One of the plantation managers in this district realizing that by proper cultivation the coffee business would still yield a profit, purchased twenty of these defunct coffee estates, and secured an able manager for each one. I visited one of these estates and saw coffee culture from the planting of the seed to the sewing up of the sacks for export. I was told that this plantation was purchased for ₱13,600 and that the profits for the first two years equaled the original cost. The estate is now valued at ₱160,000. It is apparent that the manager realizes that *good* plantation management costs money, but that in the end such management is the cheapest.

He insists that the soil under and between the coffee trees shall not be cultivated, but the weeds are pulled every ten days and the trees are also trimmed at this time. This pulling of weeds makes it possible to remove them with the least possible disturbance of the soil. The weeds and leaves are left beneath the trees. The reason for this method is to imitate as near as possible the conditions found in the natural forests. The object is to keep the trees hardy and free from disease, and to maintain these conditions the too ready growth is prevented by keeping the soil under the trees packed. On this plantation every operation is

thoroughly systematized and every cent put out for labor is for value received. The plantation is divided into several sections, each one of which is managed by a Dutch assistant.

Coffee is gathered in Java during the months of January, February, March, April, and May. The same tree is repicked every ten days. Coffee pickers earn comparatively large wages, some as high as 30 cents per day. The same day that the berries are picked they must be hulled, as otherwise a lower grade of coffee is secured. The berries are passed through the pulping machine, which removes the outer soft skin. The hulled berries are then carried by a flume to the fermenting tank. After a day or so they are removed to the drier where they are dried either by the sun or a wood fire. A machine then removes the parchment seed coat, after which the kernels pass through a cylinder which grades the coffee according to size. The round berries are worth the most and are carefully picked out by hand just before the coffee is packed. These berries are said to contain more pith, which is the part of the bean producing the most desirable flavor. The coffee is sacked in the same way as rice.

The plantation I visited contained scattering trees of Liberian coffee. These trees are allowed to grow 18 feet high. The berries are reached by means of a ladder and are picked every week during the year. No more Liberian trees are being planted.

Coffee is planted in raised seed beds that are well shaded. The seeds are planted 6 inches apart and it requires about forty days for them to germinate.

Considerable damage is done on the coffee plantations by a squirrel-like animal which eats the coffee berries.

The dapdap tree is used to shade the coffee. The trunk of this tree is also used as a support for pepper vines.

When a coffee tree dies it is replaced by another coffee tree, but when a small section of coffee trees die that section is replanted with white cacao. The white cacao trees withstand disease better than the red. Cacao trees are inspected every five days. The pods are ripe when they turn a little yellow. I was told that red ants eat the bark, which is then attacked by a fungous growth which sometimes kills the tree. When one tree is removed its place is not refilled until after one year.

Before planting cacao, a hole 1 meter each way is dug and left open for two months; the hole is then filled and after the rains have packed the soil well, a young plant is inserted. To prevent wild deer from browsing the young trees, each tree is inclosed in a bamboo structure. The cacao seeds are first germinated and are then planted in a narrow, loosely woven basket.

The seeds which are prepared for market are allowed to ferment in a box or basket covered with an old coffee sack. The seeds of both the

coffee and cacao become quite warm during the fermenting process. After two or three days the seeds are washed in water and are then dried, sacked, and shipped.

CASSAVA.

At Ngadilaoewer I visited a cassava plantation owned and operated by an Armenian. Formerly the volcanic sandy soil found here produced coffee, but owing to the drop in prices previously referred to, the coffee estates were abandoned. The owner of this plantation purchased several of these defunct coffee estates for a small sum. He pulled out all the coffee trees and planted cassava, though at the present time the price of the finished product is not as high as it was formerly.

Volcanic sandy soil seems best suited for cassava, and with such soil, planting and harvesting can be carried on at all seasons of the year.

On this plantation a stick can easily be pushed 3 feet in the soil. At one place where a man was digging a hole, I noticed that the subsoil at a depth below 4 feet contained considerable gravel. The soil was being plowed 12 inches deep with light English steel plows. Native wooden plows with wooden beams and steel points were also being used.

Cassava is planted in rows 4 by $3\frac{1}{2}$ feet apart and is cultivated the same as corn in the United States. The soil contains so much sand that it is very easy to cultivate, and can be tilled during both the dry and rainy seasons.

A red spider and root larvæ seem to be the greatest enemies. To stop planting in the infected regions is the only successful remedy known for this trouble. Para rubber is being introduced and planted in the cassava fields. This, however, is only an experiment.

Cassava is propagated by cuttings from the stem, each of which is about 8 inches long. It takes fourteen months to produce a crop. A new variety of cassava is now being experimented upon which is expected to mature in about nine months, or five months earlier than the original variety.

The roots are pulled and loaded upon large bull carts, weighed near the fields, and hauled to the mill where they are weighed again. On the plantation visited it is intended to put in 20 miles of track in the near future, which will be used both for transportation of the roots to the mill and of the pulp waste from the mill to the fields, where it will be used as a fertilizer.

In the manufacture of cassava starch the outer skin is first cut off with a bolo. The washed root is then ground fine and run through a sifting machine where the starch is separated from the cellular matter. The milky fluid is conducted through a long trough, from which it is distributed to the settling boxes. In these boxes the starch settles and the water is run off, after which the starch is taken out and dried either

in the sun or by wood fires. When thoroughly dried it is reground in a rollêr mill to a fine flour. It is then sacked and shipped.

The cellulose, containing possibly 5 per cent of starch, is ground fine and used as one ingredient in a new horse feed.

A cassava mill must always have a good supply of water, and cheap firewood is also necessary, for on damp days the starch must be dried by wood fires.

SUGAR AND TOBACCO.

The sugar estate I visited at Tymol is said to the largest and most modern one in Java.

The only land owned by this sugar company is the building site for the mill and that occupied by the houses of the Dutch employees. The other land belongs to the Javanese. Each man who belongs to the community owns one or more rice paddies. When a company desires to start a sugar plantation in a certain locality it must first get permission from the Dutch Government. Permission must then be secured from the native chief or headman of the immediate district, and finally the land is rented from the individual Javanese. I inquired what was done if the individual landowner refused to rent his land, and was told that a deep ditch was dug around his paddy so that he could get no water for irrigation. It is probable that this laborer and his family would also be refused employment on the sugar estate. These conditions are, however, very rare, as all desire the rent money and an opportunity to work on the estate.

Only one-third of the total area of land in any given community can be planted to sugar at one time, the remaining two-thirds being planted in rice, peanuts, soy beans, sweet potatoes, or corn. In many fields the rice is harvested, the land irrigated to make it soft, and the peanut seeds are dropped into a hole made by a blunt stick, without replowing the soil. The sugar planter prefers a rice crop to precede sugar, as the soil is then free from weeds.

Sugar cane is grown for seed on a small plantation located in the highlands. This arrangement is very necessary to prevent the stock from deteriorating. Seed from this highland platation is taken to the lowland estate and planted 3 feet apart in rows in a nursery bed, where it grows from January until May, when planting begins. The young plants are then pulled. The lower ends of the stems are cut with a slanting stroke and search made for a certain disease, the presence of which is shown by many red specks located especially at the joints. If several joints are affected the stock is discarded, but if only one joint is slightly affected it is used. This disease causes considerable reduction in the percentage of sugar in the cane.

In the seed bed, cane is planted 3 feet apart, but in the field 5 feet apart. The soil is well trenched by hand labor. Long ditches, both

for drainage and irrigation, extend in parallel rows from the higher to the lower side of the fields. These ditches are about 25 feet apart and 3 feet deep. During the rainy season the drainage ditches are cleaned after every rain. Rows of sugar cane extend from one drainage ditch to another. Trenches are dug in which the cane is planted. These trenches are about 2 feet deep and 2½ feet wide. The trenches are left open for a month or more so that the soil is thoroughly aërated, and the weeds are all carefully pulled. A small amount of peanut meal is first scattered in the bottom of the trench and is covered with about a 6-inch layer of loose soil. The sugar cane is planted end to end, and pressed in the soil, the buds being at the side. A little soil is then thrown on top of the cane and sprinkled with water from the trench ditches. An extra joint of cane is planted at the end of each row to replace any that fails to grow. As the shoots appear the trench is carefully filled until it is higher than the ground between the rows. The stem is thus started more than 1 foot below the surface of the soil. As the shoots multiply the soil is crowded between them. If there is no rain for a day all of these short rows are hand sprinkled. At the time of harvest the soil is dug and each stem is pulled, no cane being left in the field. Harvesting is done by gangs of laborers, each gang being paid according to the amount of work done.

The cane is carried by hand a short distance and placed on cars. Portable tracks are placed wherever harvesting is being done. Two carabaos hitched together with a yoke pull the loaded cars to the mill. The cane is hauled to the mill the same day that it is cut, and it is ground the following night and next day. The harvesting season lasts for about seven months, beginning in May, and during this time the work at the sugar mill is carried on night and day, the men working in eight-hour shifts.

The cane contains a maximum amount of sugar at a certain age and should be harvested at that time. In order that the cane may be maturing as the harvesting progresses, planting continues throughout the harvesting season. Some varieties of cane mature in twelve months, others in fifteen months.

All labor on the plantation, except in the sugar mills, is paid for by the piece. The prices are so arranged that men can not earn much over 25 cents and women over 12 cents per day. The head boss of each gang receives money daily to pay his men. The men know how much money should be paid for doing a certain piece of work and how much their portion should be. The laborers are paid each evening; this pay system seems to be very satisfactory.

Since only one-third of the lands adjoining are planted to sugar, two-thirds of the total are left for the Javanese. The plantations rent for a period of twenty-three months, which is just sufficient time to plant and harvest a sugar crop. At other times the Javanese plant such

crops as best fit the land for a future crop. On the plantation I visited 24,000 acres are planted annually. A refining machine has recently been added to the equipment of this plantation, and a fair grade of granulated sugar is now produced. During nine months of 1906 Java exported 1,500,000,000 pounds of sugar, and during the same period the exports of sugar from the Philippine Islands were about 150,000,000 pounds.

At Klatten I visited a large sugar and tobacco estate. The manager of this estate is an expert chemist, having studied two years at Columbia University, New York. This estate includes 200,000 acres of land and 60,000 Javanese live on it. On certain fields tobacco was planted, followed by four crops of rice. Tobacco and sugar cane were never grown on the same field. A large pumping station was just being installed to supply water for irrigation during the rainy season.

Peanut meal and sodium nitrate are used as fertilizers for the sugar crop.

At the time of my visit, which was about May 2, the sugar was not ready for harvest, and it was too early for planting tobacco. The people were all gathering rice, after which the soil was broken for tobacco.

Ten Javanese boys are being instructed in the chemistry of sugar. After the ten months' course the more apt ones are to be given employment as sugar testers in the mills.

There are several sugar mills on the estate, the largest one producing 100 tons daily. It requires thirty-six hours to obtain granulated sugar from the cane.

I asked the manager what he considered the most difficult problem. He replied that the growing of the cane was the only great question. Mills can be erected in a few months and there is no difficulty in securing plenty of sugar makers.

RICE.

The system of rice culture in Java is about the same as that of the Philippine Islands. Mr. Pitt, who has charge of the Government Economic Gardens at Buitenzorg, told me that the native method of culture was the best system when pursued according to the custom of the better class of natives. The application of manure has not been found practicable, as the increased yield did not justify the outlay. After one rice crop is harvested another is immediately planted. The fields are never allowed to remain idle, but are always kept in cultivation. This is in part due to the congested population, but undoubtedly greater yields are obtained than would be the case if the fields were allowed to return to jungle.

The rice is picked one head at a time, and later is sorted so that the stems of the same length are together.

About two-thirds of the soil in Java is tilled by hand labor. The

instrument principally used is a long, broad-bladed hoe with a blunt handle. Tools are made and owned by the natives. The sod on the dikes is all removed and worked into the soil for fertilizer.

KAPOK.

From the car windows I observed a large kapok plantation and was told that the kapok trees were formerly planted along the irrigation ditches throughout Java, but this custom was stopped, as the native chiefs in each section secured all the kapok.

CINCHONA.

The government cinchona plantation is located in the same volcanic basin as the Malabar tea estate. It extends along the sides of the basin for several miles and includes elevations from 3,000 to 5,000 feet. Trees at an elevation of 5,000 feet are healthier than those below or above this point. At this elevation I saw trees forty years old that were possibly 8 inches in diameter and 30 feet tall. Seeds for these trees came from South America, and from these trees seeds were secured in turn for the other cinchona plantations in Java. The sandy, volcanic soil contains plenty of humus and receives 3,000 millimeters of rainfall annually. Seeds from the older trees are used for propagation. They are planted in raised seed beds 4 by 20 feet in size. Each bed is protected from the sun, rain, and wild animals by the construction of a grass or bamboo shack. In the daytime one side is opened to receive light and air. The young plants are liable to damp off if given too much water. After six months the seedlings are transplanted to long nursery beds which are not protected. Here they remain until they are planted in the field. Plants for new and rich soils are propagated from seed, the plants intended for old or poorer soils are grafted. This is done while the trees are in the long nursery beds.

The grafting is done by the natives and the results are excellent. Both the seed beds and the nursery beds are provided with new soil every two years. The soft, mellow soil containing much more humus is preferable. The plantation I visited is terraced to prevent the washing of the soil.

The trees are transplanted from the nursery beds during the rainy season and are set out 3 by 4 feet apart. Each terrace is about 4 feet wide and slants in a little. A rectangular hole 18 inches deep by 18 inches long and 6 inches wide is dug near each tree. This hole serves as a pocket to hold rain water, it also allows the air to enter the soil and serves as a receptacle in which weeds and grass are deposited. The soil on this terrace is kept thoroughly cultivated; both men and women do this work and are paid according to the amount of land cleared. At each clearing the old holes are filled and new holes are dug.

Harvesting begins in two years and is kept up indefinitely, replanting

PLATE II.

being done where the old trees are removed. Trees are not usually allowed to grow for a longer period than five years. Harvesting is done during the dry season.

Harvesting by years.—First year, one lower branch as large as one's thumb is removed; second year, the second branch is removed; third year, every other tree is removed; fourth year, other trees are removed, replanting begins; fifth year, the largest trees are removed, replanting continues.

Very old and poor soils are fertilized with castor-bean cake, which is placed in the bottom of the holes around the trees.

When the plants are young a rather small eating insect attacks the lower side of the leaves, causing them to curl and wrinkle. The most successful method of combating this insect is to keep the plant growing so rapidly that several new leaves are formed for every leaf destroyed. After two years the plants are so thrifty that damage from this insect need not be considered. Another pest is a grub which eats the roots of the young plants. These grubs may be dug out and destroyed. A fungous growth sometimes attacks the stems and roots of the plants. The leaves turn red and eventually fall off. The plants are dug up and burned, the hole being left open, and after a year another tree is set in.

The bark is removed from the stems and roots as large as one's thumb not later than one or two days after harvesting. It is then carried to the drying house, where it is exposed either to the direct heat of the sun or to a wood fire, for which the wood from the cinchona tree is used as fuel. After being dried the bark is pounded to a powder and put up in sacks weighing 200 pounds each.

A small chemical factory at Bandoeng extracts the quinine from the crude bark. This factory is the only one in Java and uses about one-tenth of the cinchona bark grown there, the remaining 5,120,000 kilograms of crude bark being exported to Holland.

The manager of the plantation has recommended to the Government that a factory be established on the plantation. The necessity for this is evident when it is considered that for every 100 pounds of bark transported to the factory at Bandoeng more than 90 pounds is waste.

Land for cinchona is cleared in the same way as for abacá and the brush burned. The superintendent has discovered, however, that better results are obtained where the land is not burned over, and recommends that the brush be burned in piles. This leaves a large unburned area containing a great deal of vegetable matter. The logs remain on the newly cleared plantation and are not burned, but are left on the land to decay and add humus to the soil.

The percentage of quinine in the bark varies from 2 to 15. By selection and hybridizing the percentage has been considerably increased. The export of bark from this plantation was, in 1897, 300,000 kilograms

containing 4 to 5 per cent of quinine, and in 1907, 1,000,000 kilograms containing 6 to 7 per cent of quinine. It is expected that some of the trees recently planted will yield from 12 to 15 per cent of quinine.

The cinchona tree has few enemies. It is easily grown provided suitable soil conditions, elevations, and rainfall are present. It can be harvested at any time, and a delay in harvesting does not result in an injury to the product. It can be grown economically on either a large or small estate.

Two thousand natives are employed on this estate, the men receiving about 20 cents and the women about 12 cents as a daily wage. The native villages, three in number, are models of cleanliness and neatness. The manager is a thorough believer in the value of a check plot experiment system.

DOMESTIC ANIMALS.

A large number of ducks are raised in Java. The ponies, cattle, carabaos, sheep, and goats look about the same as those in the Philippine Islands, but are more plentiful. In central Java the cattle and carabaos are worth, respectively, ₱16 and ₱40 each. I traveled twenty days before I saw a pig. This is evidently due to the fact that the natives are all Mohammedans and do not eat pork.

PROCEEDINGS OF THE PHILIPPINE VETERINARY MEDICAL ASSOCIATION, MANILA, SEPTEMER 28 TO 30, 1908.

INTRODUCTORY REMARKS.

By Dr. G. E. Nesom, *President.*

Members of the Philippine Veterinary Medical Association and Gentlemen: This is the third annual assembly of this association. I say *this association* in contradistinction to another veterinary association organized in the Philippines some years ago. This may be regarded as a revival or continuation of the former, although it was perfected as entirely original. We have not held our meetings regularly up to the present time on account of the impracticability of getting together when the men were so widely scattered and transportation difficult. It is, as yow know, very expensive and consumes a great deal of time to go from one end of these Islands to the other. We have, however, gone to extra trouble on this occasion to get the men together, because all the veterinarians in the Philippines, whether connected with the Insular or military branches of the Government, are vitally concerned with the control of infective diseases decimating the ranks of domestic animals.

Following a custom which was inaugurated when this association was organized, we have arranged a programme which includes an address of welcome to be delivered on the opening of these meetings. A gentlemen who is personally and favorably known to most of you is to deliver this address. I take great pleasure in presenting to you the Hon. Newton W. Gilbert, member of the Philippine Commission, who will deliver the address of welcome on this occasion.

ADDRESS OF WELCOME.

By Hon. Newton W. Gilbert, *Member Philippine Commission.*

Mr. President and Gentlemen: I do not think I was ever more at a loss to know what to say than on this ocassion. There is no one who needs to be welcomed to Manila. I am sure the city belongs to you as much as to me or anyone else.

I know the Central Government is glad of anything that tends to help our governmental work in any particular and, as you are engaged in important work, the Central Government is glad that you are having this meeting.

I regret that I know so little about the veterinary profession. It has made its greatest development since my school days. Twenty or thirty years ago when I was a boy on a farm in Indiana, I heard very little of veterinarians and their work. We had "horse doctors," but they were as different from the veterinarians of to-day as the names are different. I know that great advances have been made in veterinary science during the last few years—advances as great as in any other branch of science. The value of such skill and scientific training is fully recognized here as is shown by the recent provision for quite an increase in the number of Government veterinary surgeons, and very soon no doubt you will have quite an augmentation of your numbers.

I feel that it is quite beyond my capacity to make a talk regarding your work, I know so little about your profession. I know that you represent a great scientific body that stands by itself, a profession about which no one should attempt to talk unless skilled in it. It would be like proposing to one of you who never studied law to talk to an audience of lawyers. Probably you could not say anything that would be very valuable to them in their work.

This is the day of specialists and every man has his particular work. The time has come when a man skilled in veterinary science is as valuable to this country as a man who is skilled in human medicine. I am not sure but that the saving of animal life in the Philippine Islands is as important to the well being of the people as being able to handle an outbreak of cholera. The life of the people of these Islands is dependent upon the life of their animals. It seems to me as I read about the outbreaks of infective animal diseases here, especially of rinderpest, that had it not been for the work done by yourselves and men like you, who have preceded you here, the Islands might have been decimated not only of their animals but of a large part of the population, which depend upon the animals for their food and their daily avocations.

I think it is a splendid thing for you to come together in these meetings, which is difficult to do in this country. It is a long way from your stations to this city, it takes a great deal of time, some of you came over troubled waters, and I imagine it costs a great deal of money. But it is certainly advisable for you who are engaged in kindred work to get together as often as possible to exchange ideas and experiences. I have no doubt that is the purpose of this meeting.

I suspect that you have encountered many difficulties while on duty in the provinces. I suspect you find the people indifferent, slow to assist you, and even distrustful of the work you are doing. Many of the people whom you are trying to assist are not appreciative of the scientific help which you are seeking to give them. This is a difficulty which I am sure has caused you to feel at times discouraged. I want to say to you that this is a difficulty that is common to every branch of Government service in these Islands. It affects your work perhaps

in a little different way, but it is a difficulty we all have to encounter in trying to introduce new methods from the scientific and governmental thought of our own country. But I do not think we should be discouraged. I think we are expected to meet such situations.

Comparatively few of the people of these Islands are educated. This will be true as long as any of us are working here, because education can not be acquired in a few years. As long as the people are ignorant you will find the same kind of difficulties that you are finding now. So if you accomplish anything in the work you must do so with the knowledge that you will not always get hearty coöperation from the people you are trying to help. It is only a manifestation of human nature—the same human nature that we have all over the world.

I congratulate you on having the opportunity to be out here away from your homes in the practice of your profession, and on the good which you will be able to accomplish by reason of your education. I think a man is to be congratulated who is so situated in life that he is being of some service to those about him. I take it that many men, young men of earnest desires, have been so situated in life that they did not do much for anybody. Every man who is out here in the service of this Government, making sacrifices as you are doing, every man who is out here doing his best work can have the consciousness every day that he is really doing something worth while, something of value to the generation in which he lives, something which will live after he is gone. That is the important thing in life anyway, and I want to emphasize it. The only thing worth while is to accomplish something for those about you, for those who are coming after you. I do not know much about the philosophy of life, but it seems to me that we are living in this life for the next generation—to give them better things than we have had.

So you are to be congratulated. I congratulate you on having the courage to undertake this work. I congratulate you on the opportunity to have these meetings in the city of Manila.

I hope they will be very pleasant and profitable, that you will all be careful to drink boiled water, or something else that will not cause illness, that you will not get sick of any disease that can not be cured by a veterinarian, and that when you return to your work it will be with renewed vigor and courage for the labors that await you.

RESPONSE.

By Dr. G. E. Nesom, *President.*

Gentlemen: This has been a year of great activity among those of us who have been entrusted with the responsibility for the suppression of animal diseases in the Philippines. The revival of business has led to an increase in the cattle trade with a corresponding increase in diseases. Army horses had to be replaced with new shipments and it has been a

problem to keep them free from diseases. It has been a greater problem to keep diseases out of private stables and off the farms.

The comparison of the relative importance of human and veterinary medicine in the Philippine Islands, as made by Commissioner Gilbert, would do credit to the most enthusiastic veterinarian and yet is not overdrawn. The very life of industry in these Islands is dependent in a large measure on the domestic animals, for the simple reason that the people have learned through generations to depend upon draft animals to perform the work which in many other Oriental countries is performed by human hands. It is not the custom here to dig the soil with hoes and spades as in Japan. When the Filipino farmer has to work in that way, he does not accomplish much in the tilling of the soil.

It must be admitted on the part of the Government officials who are charged with the suppression and control of animal diseases that we have not always understood the problems which confronted us. These years of experience which we have had have taught us many valuable lessons which had we had them years ago would have been very useful to us.

One of the most severe of these lessons for the Philippines is that the suppression of the diseases which constitute the great plagues that ravage these Islands has been prevented by the constant importation of these diseases. While we have been spending a great deal of money, time, and energy in trying to eradicate them, it has been a case of "throwing out at the window with a spoon and in at the door with a spade." In other words, the problem has not been solved largely because of the fact that we have not kept the disease from being reintroduced with the foreign shipments. Experience has taught us that this is essential. The necessary legislation to accomplish this has been enacted, executive authority for enforcing the law has been granted, and the task is actually being performed. While you have been working under the old system, when diseases were coming into the Islands faster than we were getting them out, the prospects are that your task will be much lighter in the future with the active enforcement of the law to prohibit their further importation into the country. Another practical thing which will aid us greatly in carrying on this work in the future is that we have received an increase in the total number of workers in this line. The Army in the Philippines is also constantly receiving men with high professional attainments and amply competent to handle the veterinary branch of the work. Many noted changes have occurred since we were assembled together here on the last occasion, and as a body of professional men we should feel proud of these accomplishments.

I want to say a word with special reference to agricultural inspectors and assistant inspectors. These young men come fresh from the agricultural colleges conducted under the modern system of agricultural education in the United States, are specialists in some branch of agriculture, and came here expecting to be employed entirely in agricultural

work. But their services were needed in fighting the common enemy, and they have rendered most excellent service in the suppression and control of infective animal diseases. They have done the work of veterinary surgeons and we have found them a most excellent substitute. I hope the time will come in the near future when we can relieve them from that duty. In the meantime, they are doing that work which Commissioner Gilbert has assured us constitutes one of the great things of a man's life—doing good for humanity.

There is no one problem of more vital importance to the worker in connection with the Government veterinary service than that of securing the coöperation of the local provincial and municipal officers in the performance of his work. That help has been given in an irregular way in the form of provincial and municipal ordinances and financial aid in the way of police, guards, and inspectors to assist the veterinary force in their work. We greatly desire to secure more uniformity and some positiveness of action. We want to know that whenever an outbreak occurs in a province or municipality that the people there are going to work to suppress the outbreak and incidentally call on the technical skill which we are able to give them. With this general idea in view, I have asked the Solicitor-General to look up the matter and discuss to-day what can be done under existing laws, with suggestions as to the legal aspects of this question.

CERTAIN LEGAL PHASES OF THE WORK OF THE GOVERNMENT VETERINARY SURGEONS.

By Hon. GEORGE R. HARVEY, *Solicitor-General.*

GENTLEMEN: The Director of Agriculture has asked your humble servant to submit for the consideration of this association some thoughts on the legal phases of your work. As veterinary surgeons your efforts are directed to the protection of the domestic animals of the country against disease, and the importance of your work is second only to the preservation of the health of the people. This being an agricultural country, its material prosperity depends in a very large measure upon the work animals available for the cultivation of the soil and for the transportation of its products to the points of shipment. The communicable animal diseases prevalent from time to time in different parts of the Islands, especially the rinderpest, have caused large areas to be reduced to a state of devastation and the people affected thereby have, in many instances, been left proverty-stricken. Hence time and experience have enabled the progressive element of the population to appreciate the importance of the work in which you are engaged.

The members of the Philippine Commission realized very soon after their arrival in the Islands the importance of this matter of contagious and infectious animal diseases, and they evidently gave full consideration to the matter of the ways and means of bringing about the desired

results. The first provision made by the Philippine Commission upon the subject of animal diseases was in the Municipal Code, Act No. 82, passed January 31, 1901. This code was an illustration of the fact that the purpose of the United States in the establishment of municipal governments in the Philippine Islands was, so far as practicable, to help the Filipinos to help themselves, and to teach them self-government along lines that were new and unfamiliar to them. President McKinley, in his instructions to the Philippine Commissioners, enjoined them—

> to devote their attention in the first instance to the establishment of municipal governments in which the natives of the Islands, both in the cities and in the rural communities, shall be afforded the opportunity to manage their own local affairs to the fullest extent of which they are capable, and subject to the least degree of supervision and control which a careful study of their capacities and observation of the workings of native control show to be consistent with the maintenance of law, order, and loyalty.

These instructions for the establishment of municipal governments in the Philippine Islands are based upon the principle of "self-help." It is a well-tried maxim in government as well as in other lines of human activity, that "The Lord helps those who help themselves," and this maxim is based upon the common results of human experience. The spirit of self-help is the basis of genuine growth in the individual, the community, the race, or the nation. Whatever is done *for* individuals or communities which they can and ought to do for themselves, takes away, to some extent, the stimulus of doing for themselves.

The most important function of a government is the protection of life, liberty, and property; this function the United States has undertaken to perform in the Philippine Islands, leaving it to the people to govern themselves in local affairs and doing for them only those things "which a careful study of their capacities and observation of the workings of native control show to be necessary to the maintenance of law, order, and loyalty." Upon this principle, and in accordance with the president's instructions, the Philippine Commission, in subsection (*m*) of section 39 of the Municipal Code, conferred upon the municipal council the power and duty and invested it with the responsibility of regulating the keeping and use of animals in so far as the same affect the health of domestic animals, and in subsection (*s*) of the same section made it the duty of the municipal council to "adopt such other measures to prevent the introduction and spread of disease as may, from time to time, be deemed desirable or necessary." It may be said that this is very meager authority for the enactment of ordinances by the municipal council with a view to prevent the introduction and spread of the diseases of domestic animals. This is true, but the authority seems to be sufficient, and therefore it will serve its purpose. The Municipal Code is an organic law, and it confers powers in brief terms, just as they should be conferred in such laws and in constitutions. For instance, the Constitution of the

United States confers the extensive and important powers of Congress in eighteen briefly worded clauses, and Congress has been legislating under these powers and successfully meeting the conditions which have arisen in our country for more than one hundred and twenty years.

In addition to the powers conferred upon the municipal council, as above stated, it is provided in subsection (*aa*) of said section 39, as amended by section 2 of Act No. 1791, that the municipal council shall—

> "Establish and maintain municipal pounds and fix the fees for poundage; regulate, restrict, or prohibit the running at large of domestic animals and dogs unlicensed, and provide for the distraining, impounding, and sale of the same for the penalty incurred and the cost of the proceedings; also impose penalties upon the owners of said animals for the violation of any ordinance in relation thereto," etc.

Therefore we may safely say that the municipal governments organized under the Municipal Code are vested with ample powers to enact ordinances prescribing rules and regulations for the keeping and use of domestic animals in so far as the same affect the health of such animals, and to adopt such other measures to prevent the introduction and spread of disease as may, from time to time, be deemed desirable or necessary, and may also prohibit the running at large of domestic animals, and thus protect them against communicable diseases.

The Provincial Government Act (No. 83) was passed by the Commission on February 6, 1901, after the passage of the Municipal Code, and in said Act No. 83 no provision was made for any action by the provincial authorities in the prevention or suppression of cattle diseases; it was evidently deemed advisable to leave that power wholly in the hands of the municipal authorities for the time being. Later, however, on May 22, 1901, the Commission provided in paragraph 6 of section 1 of Act No. 133 that it shall be the duty of the provincial board—

> To adopt, by resolution, regulations for the suppression of any agricultural pest, like locusts or cattle disease, to post the same in five conspicuous places in each municipality, to provide for enforcement of the same by fixing penalties for their violation not exceeding two hundred pesos fine or thirty days imprisonment, to confer jurisdiction to try violators of such regulations upon justices of the peace of the province, and to appropriate from the provincial treasury the necessary expenses in organizing the temporary force of employees needed to enforce regulations and in paying costs of prosecutions before justices of the peace. * * *

This provision, in amendment of the Provincial Government Act, places upon the provincial board much of the responsibility for the spread of communicable diseases in the province, in view of the fact that such board may enact regulations effective throughout the province and is authorized to enforce the same and provide the funds therefor.

It therefore appears that the municipalities and provinces are vested by law with ample powers for preventing and suppressing communicable

animal diseases in the Philippine Islands, in so far as the enactment of ordinances and regulations and the enforcement of the same are concerned.

The Philippine Commission, by Act No. 157, passed July 1, 1901, created the Insular Board of Health, and in section 4 of said Act vested said Board with general supervision over all the interests of the public health in the Philippine Islands, and in subsection (*b*) of said section 4 provided that—

> "It shall make inquiry and investigation into the causes, pathology, and means of preventing diseases, especially epidemic diseases, *including those of domestic animals*, together with the sources of mortalty," etc.

In subsection (*h*) of said section the Board of Health was given the following power and authority:

> It shall have power and authority to make and enforce regulations for preventing and suppressing contagious or epidemic diseases of man or animals; to abate nuisances endangering the public health; to remove the cause of any special disease or mortality; and to make and enforce such interior quarantine regulations as it shall deem necessary in the city of Manila and all other cities, municipalities, provinces, departments, or places where there are no local boards of health or health officers, and in places where boards of health or health officers exist, but where the sanitary laws or the regulations of the Board are not being carried into effect; and the power conferred upon municipal councils by section 39, subsections (*l*), (*m*), (*n*), (*o*), (*p*), (*q*), (*r*), and (*s*), of the Municipal Code shall be exercised subject to the supervision and control of the Insular Board of Health, whenever in its opinion the exigency so requires.

The provisions of said subsection (*h*), in so far as they applied to the city of Manila, were repealed by section 13 of Act No. 1150. Subsections (*m*) and (*s*) of section 39 of the Municipal Code, among those referred to in said subsection last quoted, are the two subsections under which the municipal council is authorized to enact ordinances for the prevention and suppression of animal diseases, and it will be noted that the Commission recognized in said subsection (*h*) that it might become necessary for the powers of the municipal council, under the subsections referred to, to be exercised under the supervision and control of the Board of Health, and provided for this to be done when said Board might determine that the exigency required it. So far as animal diseases are concerned, this power of the Board of Health doubtless passed to the Director of Agriculture by the terms of the "Reorganization Act," as hereafter noted.

Thereafter, on December 2, 1901, by Act No. 308, the Philippine Commission established municipal boards of health, and in section 5 of said Act provided that—

> * * * It shall have power and authority to abate nuisances endangering the public health, to remove the cause of any special disease or mortality, and to make and enforce such quarantine regulations with reference to its municipality as it shall deem necessary. It shall draft and recommend to the municipal council suitable ordinances for carrying into effect the provisions of subsections

(*l*), (*m*), (*n*), (*o*), (*p*), (*q*), (*r*), and (*s*) of section thirty-nine of the Municipal Code. During epidemics of contagious or infective disease affecting the inhabitants or the *domestic animals* of the municipality or of any of its barrios, and at such other times as may be deemed necessary by the municipal council, it shall appoint such sanitary inspectors as the municipal council may authorize. * * *

The Philippine Commission, on October 26, 1905, passed the "Reorganization Act," and in section 5 thereof the Insular Board of Health was changed to the Bureau of Health, and in subsection (*d*) of said section the veterinary division of the Board of Health was transferred to the Bureau of Agriculture, and in subsection (*b*) of section 8 of said Act said veterinary division was constituted a part of the division of animal industry created by said section in the Bureau of Agriculture; and it was provided in said subsection (*b*) that the duties and services then required of the veterinary division of the Board of Health by laws and regulations in force at that time should be performed by the division of animal industry of the Bureau of Agriculture under the general supervision and control of the Director of Agriculture.

It thus appears that the protection of the domestic animals in these Islands against epidemic diseases depended upon the municipal and provincial authorities and such coöperation as the Insular authorities were able to give them through the Government veterinarians, until the Philippine Commission passed Act No. 1760, entitled "An Act to prevent the introduction into the Philippine Islands of dangerous communicable animal diseases, to prevent the spread of such diseases within the Islands, and for other purposes." This Act was passed October 10, 1907. It will be observed from its title, as well as from an examination of its provisions, that its principal purpose was to prevent the bringing into the Philippine Islands of animals suffering from any dangerous communicable disease, and to prevent the shipment from one province, municipality, township, or settlement to another of domestic animals suffering from any such disease. It is manifest that the provisions of this Act were necessary in order that the Bureau of Agriculture might effectively aid the municipal and provincial authorities in preventing the spread of such communicable diseases in animals brought from foreign ports to the Philippines and shipped to the provinces. Notwithstanding this effective means of preventing the spread of such diseases by imported animals, and the large powers conferred upon the Director of Agriculture in said Act No. 1760, the municipal and provincial authorities are still charged by law with the duty and responsibility of preventing and suppressing epidemic diseases among domestic animals; this is emphasized by the Commission in expressly providing in subsection (*f*) of section 5 of said Act that the Director of Agriculture is authorized—

To coöperate with provincial and municipal boards in the suppression of dangerous communicable animal diseases and in the establishment and maintenance of municipal slaughterhouse and milk-inspection systems, the object of

which shall be to prevent the slaughter and sale of animals having diseases or injuries of such a nature as to render the meats and other food products derived from them dangerous or unwholesome for human food.

The provisions of law on this subject of communicable animal diseases show very clearly that it was intended by the lawmakers that in the municipalities outside of Manila the initiative should be taken by the local municipal or provincial authorities, who might, if deemed necessary, call upon the Insular authorities for their coöperation and technical assistance. In theory, the law is as it should be, and ordinarily it would work out well in practice. It is not practicable for the Bureau of Agriculture to have veterinarians in every barrio, or even in every municipality, for the prevention and suppression of these communicable diseases of animals; indeed, it is scarcely practicable for that Bureau to have a veterinarian continuously on duty in each province. For the successful eradication of these diseases from the Islands coöperation on the part of the people is necessary, and an effort must be made to have the local authorities take the action which the law empowers them to take, and in pursuance of proper ordinances and regulations to establish and maintain quarantine in infected localities, call upon the provincial authorities for the assistance which the law so clearly authorizes, and immediately to notify the Director of Agriculture, to the end that he may take steps to prevent the spread of the disease to other municipalities and provinces and coöperate with the local authorities in suppressing it. This is not merely theoretical, but altogether practicable, and it is apparently the plan intended by the Philippine Commission to be carried out in such cases.

The lack of funds for extraordinary purposes, and the restrictions placed by law upon the expenditure of municipal and provincial funds may be the causes of apparent apathy in some cases, but information from various sources shows that the indifference and even opposition on the part of ignorant people who are influenced by superstition, and also on the part of municipal officials, is the greatest difficulty encountered in fighting contagious and infectious diseases. This indicates the necessity for an earnest campaign of education with a view to bringing the people to a realization of the great benefits to be derived from science in the prevention and suppression of animal diseases. It is therefore necessary to strive with patience and perseverance for the effective coöperation of the provincial boards with the Insular authorities, and through the provincial boards to secure the effective coöperation of the municipal authorities, to the end that the people may finally see the blessings that are held out to them "without money and without price." The most valuable man in such a work is not necessarily the one who possesses the greatest knowledge of veterinary medicine, or who has had the longest experience in that profession, but the man who with his other

accomplishments and qualification for his work possesses the skill, judgment, and tact which will enable him to show the authorities and the common people the benefits to be derived from coöperation in the eradication of dangerous epidemic diseases among men and animals. Personal inconvenience and loss in individual cases are necessary in all such campaigns against disease, and the greatest patience, tact, and perseverance are necessary in dealing with those who are unable or unwilling to understand why they should undergo personal inconvenience or loss for the general welfare of the people.

In the last analysis, it would appear to be very important to strengthen in some manner the arms of the municipal authorities. They are not specifically required by law to coöperate with the provincial or the Insular authorities in suppressing epidemic diseases of animals and are therefore likely to be influenced in their actions by personal or political motives. While the powers of municipal councils seem to be adequate, it may be that the municipal officials are not generally aware of the existence of these powers. It is therefore respectfully suggested that the Governor-General, owing to his having executive supervision of the local governments, might see fit to issue an executive order calling the special attention of municipal and provincial officials to the provisions of law under which they are able to take steps looking to the prevention and suppression of the diseases of domestic animals, and directing strict compliance therewith, and especially requiring of such officials full coöperation with the Director of Agriculture and his subordinates. The Filipino people have great respect for the Chief Executive, and his order, based upon the law, would have the practical effect of law, and would doubtless facilitate the work of suppressing rinderpest and other diseases which are annually causing the Philippines the loss of millions of pesos.

It might also be suggested that it would be desirable for the Bureau of Agriculture to frame quarantine regulations which could, with propriety, be adopted by the different provincial boards. If some such plan be not followed, one municipality might enact an excellent ordinance concerning communicable diseases, an adjacent municipality an inadequate ordinance on the same subject, and still another municipality no ordinance at all. The good which could be accomplished by the municipality with an adequate ordinance would be more than nullified by the evil permitted by the municipality with either no ordinance or an ordinance insufficient to meet conditions. There would be the same result among different provinces. Instead of such a probable and deplorable condition of affairs, uniform regulations by the provinces would greatly facilitate the enforcement of the Insular laws and would give to such laws a practical application.

These observations upon the laws relating to the work in which you are engaged are made in the hope that they may be of some benefit to

the members of this association and especially to those who are new to their work in these Islands. My sincere wish is that from this paper and its discussion you will be led to a more careful study of your powers and duties under the law and to a more determined effort to render for the benefit of the Filipino people the best service of which you are capable.

THE RELATIONS EXISTING BETWEEN THE BUREAU OF AGRICULTURE AND THE PROVINCIAL AND MUNICIPAL GOVERNMENTS IN THE SUPPRESSION OF INFECTIVE ANIMAL DISEASES.

By Señor PABLO TECSON Y OCAMPO,
Superintendent of Agricultural Extension Work.

GENTLEMEN: Accustomed more to working than to speaking, I feel my courage waver in trying to address such a distinguished and cultured audience as this assembly of provincial governors and of functionaries whose duties are not only to look after and promote the forest resources, but also to preserve and improve the live stock of these Islands, at one time the Philippines not being excelled in the latter respect by any country where buffaloes, cattle, and horses flourish in abundance.

If the agricultural problem has been and is the all-important question in industrial countries like England, Germany, France, Spain, and many others, what importance should not this same problem have in the Philippine Islands, whose inhabitants live principally off the products of the soil?

But the agricultural problem in the Philippine Islands offers an aspect very different from that of other countries. I refer to the mortality among animals which are the inseparable companions and indispensable auxiliaries of the Filipino farmer. The carabao on the farms of these Islands is like the camel on the African desert, the ox or the horse in Europe, and the steam plow on the fertile and expansive fields of North America. Up to the present time it has not been possible to find an animal to take the place of the carabao for agricultural work in the Philippine Islands—neither the horse nor the mule which have been imported, due to their expensive food and the great care necessary in handling them, nor the ox, to which the farmers of these Islands are not accustomed, nor the steam plow, unless used for certain products like sugar cane, have been able to satisfactorily take the place of the carabao.

The agricultural crisis in the Philippine Islands being recognized, therefore, in view of the continued mortality among work animals, I believe that too much can not be said and done to improve these conditions. This, gentlemen, is the reason I am venturing to take up your time this afternoon in my position as superintendent of agricultural extension work in the Bureau of Agriculture, in the place of Dr. G. E. Nesom, Director of said Bureau, with the sole desire of placing before

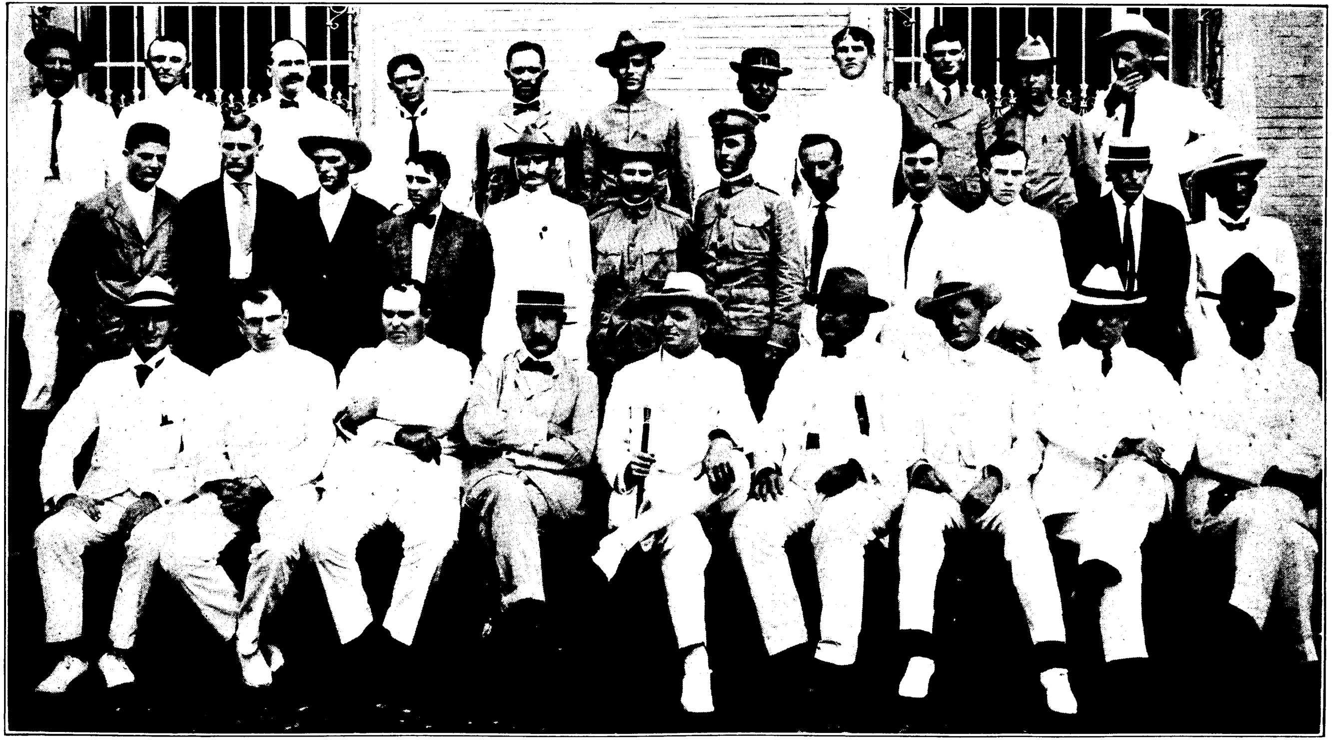

PLATE III.

you some observations which I believe necessary, taking advantage of your brief stay in the city of Manila for this purpose, and although my views may seem to you rather insignificant, being confident that your goodness of heart will permit you to see my willingness to assist in the great work of rebuilding our agriculture.

The military Government first and the Bureau of Health afterwards did not neglect to treat the various animal diseases which cause the death of carabaos, cattle, horses, etc. And later, on November 1, 1905, the veterinary work was transferred to the Bureau of Agriculture, which, as you know, is still carrying it forward as vigorously as possible.

But, like all complicated problems, the mortality among animals brought forth another difficulty besides the necessity of replenishing the stock of farm animals, that of providing the country with animals for slaughter. In order to do this it was essential to import such animals from different countries, especially China and Indo-China. In the opinion of competent persons, these imported animals have been the principal if not the only cause of the continued existence of rinderpest, foot-and-mouth disease, and other infective diseases in these Islands. The reason is very simple. The epidemics which once swept some of the provinces with such great destruction having disappeared it is to be supposed that the few animals which survived would be immune to rinderpest and therefore the offspring resulting should be also. But this did not prove to be the case, as the epidemic broke out again and continued its ravages in one province and another, reappearing several times in one locality during the same year, and so it was that the towns to which the imported animals were taken in large lots were very naturally the places reporting the disease which afterwards through lack of precautions spread to neighboring places. And if more proof than this is necessary, there arrived in Manila from foreign countries shipments which contained animals already suffering from rinderpest, foot-and-mouth disease, and anthrax.

Fortunately our people who have repeatedly given evidences of civilization and wisdom on various occasions, fortunately, I repeat, they have responded the same as their representatives in the provincial and municipal governments to the efforts of the Government and the Bureau of Agriculture every time they have had an opportunity to convince themselves of the beneficial results following the methods employed. But the question might be asked, Has this coöperation been sufficient? I believe that no one can better answer this question than the intelligent governors present here, who know their provinces from one end to the other.

You will agree with me that the Bureau of Agriculture would be able to do absolutely nothing without the efficient and helpful coöperation of the farmers, for this Bureau has neither the means nor the personnel necessary for this purpose, if all the people do not help in the work.

It can not be said that the remedies used are not effective, since in spite of many detractors, wherever inoculation has been practiced, as well as the other methods of the Bureau of Agriculture, such as the use of disinfectants, under favorable circumstances, successful results have followed, with few exceptions.

I would have brought and read here numerous letters received by the Bureau of Agriculture which would corroborate my assertions, if not for fear of tiring you. Of course we will admit that some of the agents of the Bureau of Agriculture have made mistakes in performing their work, but in every case of this kind no means have been spared to avoid a repetition of same in the future.

But what can we say relative to the attitude shown by some individuals and perhaps the persons most interested. I remember that when Hon. Juan Villamor addressed the Assembly on one occasion he said that he himself had seen some of the farmers in his province take their sick animals to the mountains in order to hide them from the veterinarians of the Bureau of Agriculture. Gentlemen, the case cited by Mr. Villamor is one of many that have occurred and perhaps are still occurring in some parts of the Archipelago. There are persons who have hidden their animals in the same town, exposing the other animals therein to contagion, persons who have cut up their dead animals in order to use the horns, the skins, or the meat for consumption or sale, others who threw their animals into the river, such as happened recently in Isabela and caused great mortality, and, lastly, others who abandon their sick animals in the fields to die and become the prey of dogs and crows and, worst of all, propagate and spread the germs of this terrible disease.

I am tempted to make a comparison of the conditions surrounding the present epidemic of cholera and those in connection with outbreaks of rinderpest and other infective animal diseases, showing the coöperation necessary to combat them which should be given by the people.

Yes, gentlemen, in order to forever exterminate the diseases now decimating our animals we need the help and coöperation not only of the provincial and municipal authorities, but of all those concerned with agriculture in the Philippines, from the wealthiest farmer to the most humble laborer.

The relations now existing between the Bureau of Agriculture and the provincial and municipal governments are undoubtedly most harmonious, and yet I believe, gentlemen, that they could be greatly improved if we truly desire to save the only real wealth of the Islands, which is agriculture. While the Bureau of Agriculture, to which I have the honor of belonging, continues this work with renewed vigor on account of special appropriations by the last Legislature which have made it possible to request more veterinarians from America, and thus more effectively meet the situation and take up new tasks which are indispensable in

order to succeed in the work of freeing these Islands of infective animal diseases, yet on the other hand the provincial boards and municipal councils fortunately enjoy ample autonomy and are able to take proper measures for stopping the ravages of such diseases. In fact, some provincial boards and municipal councils have already adopted resolutions and ordinances prescribing measures in accordance with hygiene and veterinary science.

In speaking of the autonomy, or of the power conferred by law upon provinces and municipalities to make resolutions and ordinances in necessary cases, I can not but mention that the control of animal diseases in every province and town is in our own hands, in most cases, as is also true of grasshoppers, thieves, and the public order.

As these diseases are very contagious, it is evident that by isolating the infected animals, maintaining a strict quarantine, and employing scientific remedies to destroy the agents which originate the infection, it is evident, I repeat, that by taking these precautions the disease could not spread. But if, in place of doing this, we limit ourselves to being passive spectators of the ravages of the disease, leaving the sick animals to wander at liberty through the meadows and farms, showing indifference to the results that might follow, it is also evident that the disease, far from leaving, would increase and wipe out all of our animals.

In view of what has been said, I will reproduce here Resolution No. 159 adopted by the provincial board of Tayabas on May 14, 1908, on this subject:

Whereas the provincial board is empowered to make rules and regulations regarding animal diseases, as per section 13 (*k*), Act No. 83; and

Whereas if vigorous measures are not adopted, these diseases are liable to spread to other provinces, thereby causing much damage to agriculture:

Now, therefore, the provincial board of Tayabas, in order to stop the spread of said diseases and stamp them out, adopts the following resolution:

"1. In any case of disease or death among large animals, such as horses, cattle, and carabaos, the owner thereof shall immediately report to the *teniente* of the barrio where said animal is found, who shall within twelve hours after the case is discovered advise the proper councilman, and the latter shall inform the municipal president who, together with the health officer, shall make a careful investigation and if the animal proves to be infected with rinderpest or any of the above-mentioned diseases, shall immediately order (*a*) the isolation and quarantine of the infected animal, (*b*) the cremation or burial of the animal in case of death from any of the diseases herein referred to, and shall report to the provincial governor the result of such investigation.

"2. Whenever ordered by the provincial governor the president shall gather infected animals in a suitable place within the municipality so that they may be inspected by the Government veterinarian. After this inspection the municipal president, upon the recommendation of said veterinarian, if the latter thinks necessary, must declare that infective diseases exist among animals in the municipality and immediately advise the provincial governor thereof. In such case it shall be the duty of the municipal president to immediately call a special session of the municipal council to select a place approved by the veterinarian

where a suitable corral may be constructed in which to keep the diseased animals, as well as to provide for guards for same, said corral to be so located as to prevent the spread of the disease and avoid infecting running streams, and if necessary to make appropriation to defray the expenses of so doing, and to pass ordinances for the quarantine of animals before same are allowed to leave the municipality.

"3. During the time the animals are in quarantine they may be treated either by their respective owners or by the veterinarian, provided, that such treatment will always be under the supervision of the veterinarian, and provided further, that the owner shall furnish the necessary food for the animals while in quarantine.

"4. In case of the death of any animal from these diseases the carcass shall be cremated before burial, according to the provisions of Act No. 262, passed October 11, 1901.

"5. Upon the advice of the Government veterinarian, when an animal is found suffering from any incurable contagious disease the municipal president shall cause the said animal to be killed and its carcass disposed of in accordance with section 4 of this resolution.

"6. Any person who violates this resolution or any part thereof shall be fined a sum not to exceed ₱200 or suffer thirty days' imprisonment, at the discretion of the court. The justices of the peace of this province are hereby authorized to try violators hereof.

"7. *Be it further resolved,* That eight official copies of this resolution be furnished each municipal secretary in this province, of which one copy will be for the municipal president, one for the health officer, one for the justice of the peace, and the remaining five copies will be posted in the most conspicuous places in the town. Official copies will also be furnished the Director of Agriculture and the honorable judge of the Court of First Instance of the Seventh Judicial District."

Enacted May 14, 1908.

Of course this resolution can be modified to meet the different conditions in each locality. The spirit of section 5, which obliges the municipal president to order the death of any animal suffering from an incurable disease, appears not to be in accord with certain legal principles, but in view of the great necessity justifying same it is probable that the object of this section may be attained by means of the consent of the owner, to whom should be explained the great danger represented by an animal thus condemned to death for having in its organism the germs of a fatal disease.

But it is not sufficient that ordinances and resolutions should be adopted in a few provinces only, such as Tayabas, Isabela, Benguet, Ilocos Sur, Bohol, and Nueva Vizcaya (six), and a few municipalities such as Mulanay, Tayabas Province; Ormoc, Leyte Province; Iloilo, Iloilo Province; and Catubig, Samar Province (four), which make ten in all, representing only 1⅝ per cent of the total number of provinces and municipalities in the Islands. It is very necessary that each province adopt an ordinance of this kind and that it be rigidly enforced, in order to secure uniformity in the methods employed throughout the Archipelago, for only in this way can the most successful work be done.

In order that you may observe the very beneficial results from both preventive and curative measures, as well as the serious consequences of a little neglect or indifference, permit me to relate a circumstance which in the opinion of the Director of Agriculture, who went personally to investigate the same, started the recent outbreak of rinderpest in the Province of Isabela, where the disease had not appeared for many years.

Early in last May when there were a few cases of rinderpest in the town of Solano, Province of Nueva Vizcaya, a Chinese merchant transported some goods to Tagle by means of a carabao, which was attacked with rinderpest upon arrival at that place, having brought the infection from Solano. Rinderpest immediately spread all over the municipality and some of the dead carabaos were thrown in the Cagayan River, thereby causing the death of hundreds of animals. If an ordinance had been passed in Solano at the time the outbreak was discovered placing all animals in strict quarantine it is certain that the carabao referred to above would not have been able to carry the infection to Tagle and cause the great losses in the Province of Isabela which resulted therefrom. And if similar resolutions had likewise been passed in Tagle at the time the disease appeared there, its spread would have been prevented and the bodies of dead animals would not have been thrown in the river, which would have resulted in saving the lives of hundreds of animals.

We have here, gentlemen, a clear case which should convince us once for all that rinderpest and its fellow diseases can be avoided if proper precautions are taken in time. The disease was placed under control in Isabela, thanks to the opportune trip of the Director of Agriculture, who desired to place himself upon the field in order to personally direct the campaign and persuade the authorities and the inhabitants of that fertile region to coöperate with the agents of the Bureau of Agriculture and adopt proper measures for suppressing the disease.

Toward the end of July last surra was discovered in the city of Cebu. The next day the veterinarian of the Bureau of Agriculture who was in Cebu at that time requested the provincial board to adopt rules deemed expedient by him, and in consequence of same the provincial governor approved a resolution placing all of the city in quarantine and authorizing the veterinarian to hire a sufficient number of persons to see that the quarantine was rigorously enforced. It should be stated that according to the experience of the Bureau of Agriculture the death rate from surra has averaged about 90 per cent, while in this outbreak only four horses died, the quarantine lasting but fourteen days. It can be said therefore that by the prompt and vigorous measures taken the city of Cebu prevented on this occasion the loss of thousands of pesos, taking into account the large number of horses there and in Talisay.

During the latter part of August rinderpest was discovered in Carcar, Province of Cebu and the provincial board authorized the veterinarian

of the Bureau of Agriculture to employ the necessary number of guards to maintain a quarantine in the infected district. The veterinarian therefore employed six persons recommended by the municipal president, and in four weeks the outbreak was suppressed without having spread beyond the district where the disease first appeared. This municipal president not only took an active part in the work and showed the greatest interest, but took charge of the guards and gave instructions to the *tenientes* of the barrios and the municipal police, in order that they might assist the veterinarian whenever possible. Everything which this president promised was fully complied with.

These cases, like many others which I might mention, clearly show that the fate of our work animals, as I have said before, depends upon ourselves, and that the best results are obtained by effective and continued coöperation between the provincial and municipal authorities and the people on the one hand and the employees of the Bureau of Agriculture on the other.

The example that such cases afford us serves as a model for the rest of the Islands, especially in those districts where the veterinarians find it impossible to carry out their plans on account of lack of coöperation and assistance upon the part of the persons interested.

As the Bureau of Agriculture quite often finds it impossible promptly to respond to calls for help, due to the insufficient personnel, permit me most earnestly to recommend that proper measures be taken as soon as any infective animal disease appears, without waiting for the veterinarian or inoculator, such as isolating the infected animals, establishing a strict quarantine, and applying whatever remedies may be at hand, taking care that the bodies of dead animals are immediately buried at a sufficient depth so that they can not be reached by dogs, etc., thereby spreading the infection.

And lastly, for greater convenience and in order that your coöperation may be more effective, permit me to recommend that you promptly advise the Director of Agriculture, by telegram if possible, of all necessary facts in regard to the disease, viz, name of disease, kind of animal, number exposed, sick, and dead, and name and address of informant. If it is impossible immediately to send any help and the disease continues to spread, according to reports, the Bureau of Agriculture will do so as soon as anyone is available for this purpose.

CIRCULAR.

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,
EXECUTIVE BUREAU,
Manila, October 15, 1908.

SIR: Complaints have been received in this office that indifference appears to have been displayed by officials in certain provinces and municipalities where surra, rinderpest, and other diseases still exist among

work animals and that hearty coöperation has not been given the representatives of the Bureau of Agriculture in the maintenance of the necessary quarantine and the slaughter of infected animals when such measures were deemed necessary.

These measures, which at first glance seem drastic and to a degree prejudicial to the interests of individuals, are considered justified by the necessity for suppressing the diseases mentioned which have caused and are causing such great losses to the agricultural community and a heavy expense to the country, with the least possible delay, checking the spread of the disease, and localizing the true centers of infection. The Government, having in mind that the death of work animals has been for some years the chief cause of the impoverishment of agriculturists, has considered it its duty to take energetic and effective measures in order to save the animals which still remain—measures which are beneficial to the Islands as a whole. Furthermore, the important and arduous task imposed on veterinarians of the Bureau of Agriculture fails of accomplishment too frequently by reason of lack of information as to the precise location of diseased animals and the little interest and zeal displayed by the people in the observance of approved measures, and, particularly, by reason of timely notice not being given to the proper authorities of cases which occur in the locality in order that proper remedial action may be taken in time. If officials, both provincial and municipal, do not lend decided and hearty assistance to the veterinarians in this matter, inducing the people to give due compliance without opposition of any kind to the measures, which, according to the nature and circumstances of the case, may be deemed necessary, and giving timely advice of each case which occurs, the efforts of the Bureau of Agriculture not only will constitute a considerable expense to the public treasury, but a wholly unprofitable one as well.

In view of the importance of this matter to the development and improvement of agriculture in these Islands which, as you know, constitutes the chief source of their wealth, your valuable and active coöperation, directly and through the municipal authorities, is requested in order that all will lend hearty assistance to the Bureau of Agriculture for the purpose of attaining the end sought.

Kindly acknowledge receipt of this communication and report action taken in accordance herewith.

By direction of the Governor-General:

F. W. CARPENTER, *Executive Secretary.*

To all provincial governors, Philippine Islands.

IRRIGATION METHODS.[1]

A. S. KENYON, C. E., *Engineer for Agriculture.*

A correspondent writes asking for some notes on the amount of water necessary for the growth of different crops, the best means of applying the water, the number of applications, and the periods of the year for watering. This makes too much of a demand upon the limited space available for "Answers to correspondents" so that the reply is given here in the ordinary pages of the Journal as being of general interest.

In the first place, the volumes of water required for the full growth of various crops will vary much. Water is directly required by plants for transpiration or evaporation through the surfaces of their leaves, consequently the amount of foliage is an important factor, and for the formation of their actual bulk, of which water is a large constituent, running, in some cases, over 90 per cent; but its greatest service is in dissolving and thus rendering available, the plant foods contained in the soil. In many parts of the State, winter crops get sufficient moisture from the heavens for all their requirements, at any rate with proper cultivation, while the same may be said to a less degree of summer crops. The latter may be successfully grown, without artificial aid in watering, over large areas where they are at present either whole or partial failures, by the adoption of improved methods which are, in general, sowing in drills sufficiently wide apart to permit of cultivation and, especially after rains, the frequent use of the horse-hoe or scuffler, between them. But in other localities—over the greater part of our northern districts—winter crops require additional moisture in many, nay, most years, and the summer crops always. The supply of these requirements is met by irrigation which may be derived from public works under the State rivers and water supply commission or from private sources, such as pumping plants or by the construction of dams. It is well to bear in mind that by the Water Act 1905, the water in all rivers, creeks, lakes, lagoons, or marshes, even if wholly on private land, is the property of the Crown and can only be used lawfully for irrigation under the authority of the Commission. True, riparian owners are entitled to the free irrigation of 3 acres; but only in direct connection

[1] Published in the "Journal for the Department of Agriculture of Victoria," vol. 6, Part I.

with a homestead or for its service, so that the exception is only trifling. Licenses to divert water from any source may be obtained on reasonable terms and give a much-desired security of tenure.

Having obtained the water, care must be taken in applying it to the ground so as to make a thorough job of it. Mere soaking of the top few inches only means early loss by evaporation with but little water reaching the subsoil to be there stored for future use. Surface roots are encouraged and a brief stimulus given the plant, too soon to be lost. As water can not be forced into the ground, sufficient time must be allowed for it to soak in and penetrate to a reasonable depth. The time necessary may be as little as fourteen hours, but will generally amount to twenty-four or over. The volume of water necessary will depend upon the character of the soil and upon the method of distributing adopted; the rooting character of the plant will also be a factor, tomatoes and lucerne, for instance, requiring very different volumes. The volume may vary from 3 inches or under to as much as 20 inches in depth over the whole surface. The most usual depth is found to be about 7 inches. One inch in depth over a surface of 1 acre is equivalent to 23,000 gallons or 3,630 cubic feet.

The best means of distributing the water so as to reach the plant's roots, is undoubtedly by underground perforated pipes; but this is a very costly method and one not likely to be brought into use here for some time to come. The next best is by distributing furrows. The furrows are plowed out by the ordinary garden or orchard plow and generally along the line of fall, the plants being sown in drills to suit. The distance apart of the furrows depends upon the nature of the soil; but 6 to 8 feet may be taken as the furthest and 3 feet as the most general. For fruit trees, only two furrows are used for the first two years, one on each side of the row. Later, as the root system increases, four or five furrows in each, depending upon the distance apart of the trees, are adopted. The water is let into the furrows from a head ditch or distributary channel by outlets made of iron pipes, wooden boxes, or simply shovel cuts secured from washing out by wisps of straw or grass. Largely the amount let out to each furrow must be determined by experience and "rule-of-thumb" methods. The length of the furrows varies with the nature of the soil, the slope, and the natural features; they should rarely exceed 10 chains in length and are more generally about 5. Sufficient flow should be allowed into each to just reach the lower end after thoroughly soaking the ground on the way. As soon after each watering as the state of the soil will permit, the scuffler or harrows should be run over the surface to form an earth mulch to retain the moisture. Cultivation as soon as possible after watering is not only essential for the furrow method, but for all the systems.

The corrugation or permanent furrow is the next way of distributing

the irrigation water. For lucerne, the greatest of the fodder crops, this system is eminently suitable, it being perennial and profiting by frequent watering. In this system, the plant is grown along low ridges and the shallow hollows or depressions between are used for distributing the water much the same way as for furrows. After cultivation is, of course, essential, care being taken to preserve the shape of the corrugations. Owing to the permanent character of the furrows, watering is much simpler and more certain. Once in working order and the irrigator familiar with his ground and its requirements, water may be turned on into the head ditches and allowed to distribute itself, saving a lot of labor and annoyance.

In the spreading system, distributing channels are run along contours, that is on lines of the same level, at distances of several chains apart. The water is let out from a distributary by any of the means already described and at frequent intervals; it is allowed to flow slowly over the surface to the next contour channel which picks up any surplus. When well arranged, the result should be the same as in the furrows, very little reaching the end beyond that required to soak the soil in the immediate vicinity. If the land has been well graded and leveled, this is a fairly simple operation and the water will need but little coaxing or blocking with the long-handled shovel to spread over the whole surface between the contour drains. Plenty of labor at the outset in land preparation and efficient system will tend to greatly reduce the labor required in distributing, and as the latter is a continuous expense, no pains should be spared to reduce it to its lowest limits compatible with good work.

The flooding or check system comes next in order of merit. Check banks which are advisably made low and wide so that implements may be worked over them, and at intervals to allow of 6 inches in depth of water at most being put on the land. In somewhat undulating country the check banks may be with advantage run on the contours, each being 4 inches lower than the previous one. When flooded in a check the result will then be 2 inches in depth at the upper end and 6 inches at the lower, the water being about flush with the top of the check bank. With the section generally adopted, narrow and high, there is a considerable liability to break away causing a loss of water and damage to crops. If the ground is tolerably level, the check banks may be run in straight lines, to suit cultivation and harvesting, inclosing from 5 to 10 acres in each check. This brings the description of distributing systems to a conclusion, for the letting of water on to a paddock to find its way as best it can over the surface, forming islands and leaving pools is not a system, though unfortunately only too common in practice. Too much stress can not be laid upon the three cardinal requirements for successful irrigation: preliminary grading or leveling of the land to be watered; allowing sufficient time for thorough soaking; and surface stirring as early as possible after watering.

PLATE IV.

In all cases see that the seed bed is moist. Land may be watered before plowing or after; but the moist seed bed is essential. It may, of course, be due to natural causes without any watering. For winter crops, the next watering depends upon the season. It may not be needed until late in September, and sometimes not at all. A third watering is but rarely called for. For summer crops water seed beds as before, then give another watering about a fortnight after sprouting and a third in another four weeks or so as the season requires. This should be sufficient to give a full and mature growth. In the case of lucerne, a watering should be given immediately after each cutting, and then get to work with the harrows. This, with favorable conditions, may mean that five or even more waterings may be needed. For fruit trees, four waterings at most will do, save in exceptional seasons, and vines do with one less. Crops of the market garden order will probably require more frequent attention; but as they will in general be of small extent only, they can be sufficiently satisfactorily dealt with. If supplies are drawn from a public channel, provision will need to be made to store some water for this purpose as the channel will, in all probability, be empty for longer intervals than the plants will stand. Tanks are cheaply constructed and with a pump available, the soil may be used to form a basin above the level, from which the water may be gravitated as required.

The above notes will serve as a general answer to the queries given at the head of this article, but it is well to remember that only broad principles can be given the cultivator on paper. The irrigator himself must solve most of the problems—and they will not be few—that will arise. Hired labor will seldom be satisfactory. The successful irrigator will always be the small holder who can give his personal attention to a small area and work it thoroughly. As for the larger holders, profits are to be made even with rougher and cheaper methods of distribution; but not to the extent possible with the smaller man.

As a parting word, never let the water touch the stems of growing plants in hot weather, else you run serious risk of injury to the plant. As to results to be aimed at, if fruit growing is the selected way, little improvement is possible upon the existing methods of cultivation and watering in vogue in Mildura and in the Goulburn Valley. If fodder and its conversion into animal products per medium of the cow or the sheep is chosen, then use all endeavors to get a good standard of lucerne. Do not graze, but cut it and hand feed; and prepare to cut it out at intervals of from five to eight years and resow after an interval of other crops.

AGRICULTURAL CONDITIONS IN THE PROVINCE OF PAMPANGA.

By Pablo Tecson y Ocampo.

The Province of Pampanga, which is situated in the central part of Luzon, is one of the most important sections in the Philippines for the production of sugar, rice, and corn.

The following information upon the present agricultural conditions was gained during a recent visit to this province. The outlook in general is very favorable; the present crops of corn and rice are doing well, and there is no animal disease except in a few municipalities where foot-and-mouth disease is reported.

The topographical conditions in the several municipalities of Pampanga are so different that I will discuss each of them separately.

SAN FERNANDO.

In this municipality are grown sugar, rice, and corn, of which the principal crop is sugar. The outlook for sugar cane and rice is promising, but there is not sufficient rice to meet the annual local demand. Within the jurisdiction of this municipality there is a creek named "Samaya" through which flows a sufficient volume of water to irrigate a portion of its lands; but as there is no dam capable of holding and distributing the water it affords very little benefit.

MEXICO.

Mexico also raises sugar, rice, and corn, having the same conditions as those of San Fernando, both as to products and the present conditions of crops. Mulberry plantings are found here, especially in the town itself.

A considerable portion of agricultural land in Mexico becomes flooded during the rainy season as a result of the shoal formed in one of the creeks within the jurisdiction of Arayat. There is also a creek known as Balas, which carries water all the year round and could irrigate one-third of the rice land if the water were utilized and dikes built up.

ARAYAT.

The sugar-cane and rice crops are very promising in Arayat. A large tract of land lying in this municipality formerly yielded thousands of cavans of rice, but since shoals have been formed by the Inomang-baca Creek at Buracan and Patayum, the waters have not been able to flow through the Santa Ana Creek and the one leading to Mexico, its usual channels, with the result that this land has become flooded and forms the bed of a small lake, thus being unavailable for agricultural purposes. Arayat is losing in this area alone about 30,000 cavans of rice every year. If these obstructed places were dredged, not only would the inundated fields be drained, but the lands beyond these places, along the creeks mentioned above, could be irrigated.

There are other larger tracts comprising the barrios of Candating, San Mateo, Guemasan, and Batasan, in Arayat, that are at present uncultivated. They are of no use now to their owners as they become flooded during the rainy season, owing to the bad condition of the road leading from Arayat to Cabiao (Nueva Ecija). Before this road was destroyed it served the purpose of a retention wall and protected crops from the constant overflows of the Rio Grande of Pampanga.

During this time the barrio of Candating raised annually 36,000 pilones of sugar and about 21,200 cavans of rice; that of San Mateo produced about 10,900 pilones of sugar and about 29,000 cavans of rice; that of Guemasan approximately 4,500 pilones of sugar; and that of Batasan about 10,500 pilones of sugar and 9,400 cavans of rice. But since the destruction of the road which protected these barrios they no longer produce such crops.

This road should be reconstructed, as it will not only protect the agricultural interests of these important barrios, but will also be a means of communication between Pampanga and Nueva Ecija.

CANDABA.

Candaba raises rice, sugar cane, and corn. Rice is the principal product and the acreage planted in it is yearly extending far and wide.

During the rainy season the large part of the low land becomes flooded and forms a lake which is called "Pinac de Candaba." Many fish are found here, which are caught by the people from this and the neighboring towns. The returns in fish during rainy seasons are estimated at about ₱30,000.

SAN LUIS AND SAN SIMON.

These two municipalities are similar to Candaba in crops and typographical situation, and the "Pinac de Candaba" extends to their lowlands. There are a large number of bamboo trees affording a great source of wealth to the people, but their crops of rice are not sufficient to supply the annual local demand.

APALIT.

The staple product of Apalit is sugar.

The agricultural lands, that portion of Candaba, San Simon, and Apalit watered by the Rio Grande of Pampanga, depend entirely upon the preservation of the provincial road leading from Apalit to Arayat. If this road should be destroyed, it would cause considerable damage to agriculture.

All the municipalities mentioned above feel the need of a canal starting at Arayat and crossing over the mangroves of Macabebe, which will serve the purpose of an outlet. This is the only improvement they eagerly desire at present for the benefit of the agricultural interests of that section.

This matter, in the opinion of the writer, deserves special attention and study, since it affects large tracts of rice land and would promote the welfare of many towns.

MACABEBE AND MASANTOL.

Rice is the principal product of these towns; sugar and nipa palm are next in importance. The rice lands are nearly all lowlands, which, according to the season, produce one or two crops a year—one during the months of April and May and another during the months of September and October.

The first crop is at present (September) being harvested and, due to the floods in the months of July and August last, has sustained considerable loss. This early crop depends upon the weather and is consequently very uncertain. In times of great and extended overflow, which occur almost every year, it is a failure.

For the benefit of the early crops and the improvement of agricultural conditions it is necessary to build walls along the Rio Grande de la Pampanga to protect crops from the destruction caused by floods.

The second or late crop which is planted during the months of December and January, on the contrary, often suffers for lack of fresh water.

MAGALANG.

Sugar cane, rice, and corn are grown in Magalang. Considerable quantities of rice and sugar are exported annually, and the corn crop of late has been plentiful. The sugar cane is doing well, and the condition of rice is promising in spite of the delay in planting due to foot-and-mouth disease which for some time rendered the carabaos useless. However, no contagious disease is at present reported among the draft animals of this municipality.

The property owners in this section, whose rice paddies are frequently destroyed by the constant overflows on the Quitañgil Creek, owing to a shoal formed at its mouth, have raised a subscription amounting to

₱1,000 for the purpose of improving their lands. They appointed the ablest among them to direct the work, and cleaning and dredging were begun on May 1. As the sum gathered has not been sufficient to accomplish the undertaking the destructive effects of the overflows will in the meantime continue. When this improvement is completed some 800 hectares of rice lands will be protected against the overflows of the creek, which will assure good crops, and also 400 hectares more, at present entirely uncultivated, will likewise become productive.

MABALACAT.

This municipality also produces sugar cane, rice, and corn, and the annual exports of rice and sugar are quite considerable. Sugar is the principal crop, but this year the growth has been unsatisfactory on account of excessive rains. The rice fields are looking fine although the planting was delayed by the same animal disease which existed in Magalang.

Mabalacat is crossed by a number of creeks which furnish it with water at all seasons of the year. Several landowners are using the water of these creeks for the benefit of their crops, by means of irrigation systems constructed to suit the needs of their own farms exclusively. Several farmers are able to gather two crops each year, though the second, which is harvested in May, is comparatively small.

ANGELES.

The staple product in this town is sugar. Rice is also grown, a portion of the rice lands producing two crops a year, though the second crop is much smaller than the first. But in spite of these two crops annual production is not sufficient for the local consumption. Beside these crops there are some maguey plantations covering an area of over 8 hectares.

There is a river called Abacan as well as a number of springs. These furnish water all the year around, irrigating several farms through proper methods. Should these waterways or creeks be made available for irrigation systems, and their use and distribution properly regulated, agricultural conditions in this town would be greatly improved. Such crops as coconuts, coffee, cacao, and oranges could probably be grown successfully if this were done, since they seem well adapted to the character of the soil found here.

PORAC.

Sugar, the principal product of Porac, is doing fairly well, as is also the case with rice. Good returns are expected from both. Rice is raised twice a year, but the second crop is smaller. The local demand for this article exceeds the production from both crops.

A number of cacao and coffee trees which have attained very good development are found in this town.

There is quite a large river here and several springs which carry sufficient water at all seasons of the year. This is used by a number of people either to irrigate their lands or to run wheels for sugar milling.

BACOLOR.

Bacolor's principal products are rice and sugar, large quantities of which are exported each year. Corn, indigo, and several garden vegetables are also raised. Some farmers succeed in raising two crops of rice a year by means of irrigation, but the second does not compare with the first.

There are a number of large creeks, from which several farmers derive sufficient water to supply their irrigation systems. The Gogo, Potrero, and Parua Creeks, well suited for irrigation purposes, supply water to irrigate about 8,000 hectares for the early crop and about 6,000 hectares for the late crop. But the existing systems of irrigation are not properly regulated for the whole section. The Potrero Creek destroys crops at times, owing to the lack of a natural exit just where most of the rice plantations are located, especially in Bacolor, which annually suffers from its effects. The sand and stones carried by the current of this creek cover the fields and render them unarable.

SANTA RITA.

Rice and sugar are the main products of Santa Rita. Rice produces two crops a year and there is a good crop of sugar. Both of these products are generally exported despite the fact that the Potrero Creek is responsible sometimes for the destruction of a portion of the rice crop.

There is a creek here called Sapang-balen, which is the principal water supply both for the people and most of the agricultural lands.

GUAGUA.

Sugar and rice are Guagua's principal products, both being exported every year, notwithstanding part of the latter is annually damaged by the Potrero Creek. Corn is of secondary importance. Two crops of rice are grown, although the second is smaller, amounting to but one-tenth of that gathered first, owing to the fact that the volume of water carried by the creeks is reduced during the hot season.

This municipality is crossed by three large creeks named San Jose, Ebus, and Malabayan, which furnish water during the whole year and of which the farmers take advantage for the benefit of their lands.

Before the revolution, in order to promote the agricultural interests of this section, the people of the town started to dig a canal about 2 kilometers long by 7 meters wide and 8 meters deep, beginning at the

Porac River and extending as far as the highest place within the jurisdiction of this town, so that it might irrigate the Guagua rice paddies. When they are able to accomplish this purpose they expect to get two certain and abundant crops of rice each year.

LUBAO.

The staple product of Lubao is rice, although sugar and corn are also grown to a large extent. Large quantities of rice and sugar are exported each year.

There are three large rivers—Porac, Gumain, and Caulaman—and six creeks, furnishing water all the year round. With this supply of water the farmers are able to irrigate their lands and grow two abundant crops of rice each year. Part of the rice harvested in the last season of May and June is still unthreshed.

There are still uncultivated lands in this municipality owing to lack of draft animals.

FLORIDABLANCA.

Sugar is the main product of Floridablanca, though a considerable quantity of rice and corn is also raised. Sugar and rice are annually exported from this place, which proves that these crops exceed the local consumption. The farmers in this town obtain two crops of rice and corn, although the second crop only amounts to one-half of the first, as a result of the defective irrigation system.

Floridablanca is crossed by the same rivers that flow through Lubao, as well as by a number of creeks, and there is a large volume of water at all seasons.

Holdings here are concentrated in the hands of a few farmers, who devote large tracts of land to maguey and coconuts beside the usual crops of rice and sugar cane.

There still remains here, as in so many places in Pampanga, much land lying fallow for lack of labor and draft animals.

CROPS PLANTED AND HARVESTED AND CONDITION OF SAME TAKEN FROM MONTHLY CROP REPORTS FOR THE MONTH OF AUGUST, 1908.

[RICE.—Attention is invited to the fact that this article should be understood as being in the unhulled state.]

Province and crop.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Albay (reports from 13 towns):	*Hectares.*		*Hectares.*		
Rice	2,996	Good	10	145	Cavans.
Abacá	2,256	do	5,730	24,220	Piculs.
Coconuts		do		671,830	Nuts.
Corn	47	do	577	4,445	Cavans.
Ambos Camarines (reports from 27 towns):					
Rice	1,132	do	11	30	Do.
Abacá	462	do	2,835	8,105	Piculs.
Coconuts		do		193,700	Nuts.
Corn	89	do	393	3,621	Cavans.
Antique (reports from 8 towns):					
Rice	1,057	Fair	10	60	Do.
Abacá	104	Good	8	4	Piculs.
Coconuts		do		14,000	Nuts.
Corn	10	Fair	10	60	Cavans.
Bataan (reports from 4 towns):					
Rice	72	Good			
Corn		Fair	325	3,060	Do.
Coconuts		do			
Sugar cane		do			
Batangas (reports from 13 towns):					
Rice	1,100	do	215	968	Do.
Corn		do	1,954	4,340	Do.
Coconuts		do			
Abacá		Good	15	45	Piculs.
Benguet (reports from 13 towns):					
Rice	172	do	47	592	Cavans.
Sugar cane		Fair			
Corn		Good			
Bohol (reports from 28 towns):					
Rice	1,062	do	154	1,000	Do.
Abacá	2	do	241	396	Piculs.
Coconuts		do		1,151,400	Nuts.
Corn	187	do	2,623	23,255	Cavans.
Bulacan (reports from 12 towns):					
Rice	8,735	do			
Sugar cane	30	do			
Abacá		do			
Corn	85	Poor	40		
Cagayan (reports from 12 towns):					
Rice	375	Good			
Coconuts		Excellent		10,000	Nuts.
Sugar cane	182	Good	43		
Corn		do	560	20,800	Cavans.
Capiz (reports from 20 towns):					
Rice	9,443	do	275	5,330	Do.
Abacá	2,115	Fair	123	701	Piculs.
Corn	65	do	375	1,102	Cavans.
Cavite (reports from 11 towns):					
Rice	5,590	Good	20	300	Do.
Abacá	50	do	8	116	Piculs.
Corn		Fair	100	5,000	Cavans.
Sugar cane		Good			

Crops planted and harvested and condition of same taken from monthly crop reports for the month of August, 1908—Continued.

Province and crop.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Cebu (reports from 32 towns):	*Hectares.*		*Hectares.*		
Rice	824	Good	53	110	Cavans.
Maguey	116	do	65	175	Piculs.
Coconuts		do		352,100	Nuts.
Corn	2,934	Fair	11,454	53,979	Cavans.
Ilocos Norte (reports from 9 towns):					
Rice	12,958	Good			
Maguey	71	do			
Sugar cane	5	do			
Corn	2	do	2,027	7,500	Do.
Ilocos Sur (reports from 18 towns):					
Rice	7,165	Fair			
Coconuts		Good			
Maguey	32	do			
Corn	70	do	2,525	3,910	Do.
Iloilo (reports from 14 towns):					
Rice	19,399	do	600	5,000	Do.
Coconuts		do		89,000	Nuts.
Abacá	405	do	100	300	Piculs.
Corn	50	Fair	757	5,265	Cavans.
Isabela (reports from 6 towns):					
Rice		Good			
Sugar cane		do			
Corn		do			
La Laguna (reports from 17 towns):					
Rice	8,572	do	59	1,010	Do.
Abacá	30	do	37	89	Piculs.
Coconuts		do		204,000	Nuts.
Corn	125	do	149	72	Cavans.
La Union (reports from 10 towns):					
Rice	3,279	do			
Coconuts		do		46,800	Nuts.
Sugar cane		do			
Corn		do	1,632	8,172	Cavans.
Lepanto-Bontoc (reports from 15 towns):					
Rice	1,254	do	50	2,500	Do.
Coconuts		do			
Corn		do	11	33	Do.
Sugar cane		do			
Leyte (reports from 20 towns):					
Abacá	472	do	3,931	15,111	Piculs.
Coconuts		do		858,776	Nuts.
Corn	301	Fair	1,309	12,768	Cavans.
Rice	2,906	Good			
Mindoro (reports from 3 towns):					
Abacá		Fair	60	150	Piculs.
Coconuts		do		20,000	Nuts.
Rice	900	Good	20	220	Cavans.
Misamis (reports from 6 towns):					
Rice	588	do			
Abacá	17	do	246	3,079	Piculs.
Coconuts		do		771,358	Nuts
Corn	7	Fair	184	3,100	Cavans.
Moro (reports from 7 towns):					
Rice	51	do	137	5,125	Do.
Abacá	8	Good	81	1,072	Piculs.
Coconuts		do		177,819	Nuts.
Corn	14	do	105	1,455	Cavans.
Nueva Ecija (reports from 16 towns):					
Rice	33,760	do			
Corn	88	do	1,498	24,648	Do.
Coconuts		do			
Sugar cane		do			
Occidental Negros (reports from 16 towns):					
Rice	6,774	do	5	500	Do.
Coconuts		do		84,200	Nuts.
Sugar cane	530	Excellent	1,120	5,800	Piculs
Corn	15	Good	3,955	166,610	Cavans.
Oriental Negros (reports from 11 towns):					
Rice	395	do			
Abacá	15	do	421	1,190	Piculs.
Coconuts				417,600	Nuts.
Corn	1,863	Fair	1,441	3,558	Cavans.

Crops planted and harvested and condition of same taken from monthly crop reports for the month of August, 1908—Continued.

Province and crop.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Pampanga (reports from 10 towns):	*Hectares.*		*Hectares.*		
Rice	10,146	Good	20	35	Cavans.
Sugar cane		do			
Corn		do	320	1,840	Do.
Pangasinan (reports from 36 towns):					
Rice	68,037	do			
Abacá		do			
Coconuts		do		293,800	Nuts.
Corn	262	do	4,305	29,450	Cavans.
Rizal (reports from 14 towns):					
Rice	3,700	do	15	350	Do.
Sugar cane	297	do			
Corn	21	do			
Abacá	11	do			
Samar (reports from 19 towns):					
Rice	492	Fair			
Abacá	518	Good	2,507	4,520	Piculs.
Coconuts		Fair		1,417,735	Nuts.
Corn	126	Good	185	447	Cavans.
Sorsogon (reports from 20 towns):					
Abacá	338	do	3,988	9,224	Piculs.
Coconuts		do		382,900	Nuts.
Sugar cane	328	Fair	100	67	Piculs.
Corn	284	Good	284	1,099	Cavans.
Surigao (reports from 3 towns):					
Abacá	26	Fair	250	1,250	Piculs.
Coconuts		Good			
Sugar cane		Excellent			
Corn	105	Good			
Tarlac (reports from 10 towns):					
Rice	35,397	do	10	50	Cavans.
Corn	228	do	200	135	Do.
Sugar cane		do			
Coconuts		do			
Tayabas (reports from 23 towns):					
Coconuts		do		2,105,200	Nuts.
Rice	1,095	do		2,205	Cavans.
Abacá	181	do	299	1,720	Piculs.
Corn	31	Fair	41	126	Cavans.
Zambales (reports from 7 towns):					
Rice	651	Good			
Coconuts		do			
Sugar cane		do			
Tobacco		do			

CROPS PLANTED AND HARVESTED AND CONDITION OF SAME TAKEN FROM MONTHLY CROP REPORTS FOR THE MONTH OF SEPTEMBER, 1908.

[RICE.—Attention is invited to the fact that this article should be understood as being in the unhulled state.]

Province and crop.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Albay (reports from 9 towns):	*Hectares.*		*Hectares.*		
Abacá	278	Good	6,830	20,510	Piculs.
Coconuts		do		613,520	Nuts.
Sugar cane	12	do	157	93	Piculs.
Corn	3	Fair	147	475	Cavans.
Ambos Camarines (reports from 21 towns):					
Rice	3,366	Good	52	797	Do.
Abacá	99	do	2,045	14,036	Piculs.
Coconuts		do		121,500	Nuts.
Sugar cane	12	do	118	5	Piculs.
Antique (reports from 4 towns):					
Rice	1,792	do	55	250	Cavans.
Abacá		do	100		
Coconuts		do		4,000	Nuts.
Sugar cane		do			
Bataan (reports from 5 towns):					
Rice	12	do			
Coconuts		Fair			
Sugar cane		Good			
Corn		do	312	2,628	Cavans.
Batangas (reports from 10 towns):					
Rice	800	Poor	8,725	110,655	Do.
Sugar cane		Good			
Corn	350	Poor	169	420	Do.
Abacá		Fair			
Benguet (reports from 7 towns):					
Rice		Good			
Sugar cane		do			
Corn		do			
Coffee		Fair			
Bohol (reports from 27 towns):					
Coconuts		Good		1,888,500	Nuts.
Rice	580	do	750	5,500	Cavans.
Abacá	45	do	545	278	Piculs.
Corn	1,013	Fair	932	1,147	Cavans.
Bulacan (reports from 10 towns):					
Rice	9,440	Good	90	240	Do.
Sugar cane	30	Fair			
Corn	85	Poor			
Cagayan (reports from 5 towns):					
Rice	18	Good	153	1,295	Do.
Sugar cane		do			
Corn		do	1,620	30,600	Do.
Coconuts		do			
Capiz (reports from 13 towns):					
Rice	2,075	Fair	3,471	18,255	Do.
Abacá	4,095	do	981	1,141	Piculs.
Coconuts		do		121,000	Nuts.
Sugar cane		do	18	26	Piculs.
Cavite (reports from 8 towns):					
Rice	1,547	Good	160	14,900	Cavans.
Abacá	40	do	6	12	Piculs.
Coconuts		do			
Sugar cane		do			

Crops planted and harvested and condition of same taken from monthly crop reports for the month of September, 1908—Continued.

Province and crop.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Cebu (reports from 28 towns):	*Hectares.*		*Hectares.*		
Rice	833	Good	364	1,655	Cavans.
Coconuts		do		414,100	Nuts.
Sugar cane	345	do	142	1,690	Piculs.
Corn	3,162	Fair	17,230	138,578	Cavans.
Ilocos Norte (reports from 7 towns):					
Rice	4,145	Good	5	175	Do.
Coconuts		do			
Sugar cane		do			
Corn	64	do	5	10	Do.
Ilocos Sur (reports from 15 towns):					
Rice	636	do			
Sugar cane		do			
Maguey	10	do			
Corn	80	do	30	300	Do.
Iloilo (reports from 10 towns):					
Rice	12,286	do	50	250	Do.
Coconuts		do		23,500	Nuts.
Sugar cane	400	do		20	Piculs.
Abacá	450	Fair			
Isabela (reports from 3 towns):					
Rice		Good			
Sugar cane	2	do	2		
Corn		Fair	200		
La Laguna (reports from 12 towns):					
Rice	1,990	Good	130	2,145	Cavans.
Abacá	30	Fair	12	52	Piculs.
Sugar cane	15	do	15	45	Do.
Corn	20	Good	4	8	Cavans.
La Union (reports from 8 towns):					
Rice	12,850	Fair	25	300	Do.
Coconuts		Good		12,000	Nuts.
Sugar cane		do			
Corn	5	do	332		
Lepanto-Bontoc (reports from 10 towns):					
Rice	170	do	11	60	Do.
Coconuts		do			
Sugar cane		Fair			
Corn		Good			
Leyte (reports from 13 towns):					
Rice	835	do	2	99	Do.
Abacá	3,020	Fair	6,931	10,293	Piculs.
Corn	609	do	1,119	7,403	Cavans.
Coconuts		Good		1,589,190	Nuts.
Mindoro (reports from 2 towns):					
Rice		Fair	200	3,000	Cavans.
Abacá		do	70	695	Piculs.
Coconuts		do		20,000	Nuts.
Misamis (reports from 7 towns):					
Rice	280	Good	71	3,190	Cavans.
Abacá	16	Fair	275	4,149	Piculs.
Coconuts		Good		753,000	Nuts.
Corn	50	do	189	6,015	Cavans.
Moro (reports from 4 towns):					
Rice	31	do	79	70	Do.
Abacá	5	do	55	605	Piculs.
Coconuts		do		14,000	Nuts.
Corn	21	do	145	750	Cavans.
Nueva Ecija (reports from 14 towns):					
Rice	1,048	do	2	250	Do.
Coconuts		do			
Sugar cane		do			
Corn	11	do	263	8,320	Do.
Occidental Negros (reports from 10 towns):					
Rice	1,450	Fair	270	1,530	Do.
Coconuts		Good		38,500	Nuts.
Sugar cane	499	do	950	6,800	Piculs.
Corn	2,020	Fair	440	3,760	Cavans.

Crops planted and harvested and condition of same taken from monthly crop reports for the month of September, 1908—Continued.

Province and crop.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Oriental Negros (reports from 5 towns):	*Hectares.*		*Hectares.*		
Abacá	55	Good	216	200	Piculs.
Coconuts		do		177,500	Nuts
Corn	1,000	do	32	3,500	Cavans.
Rice	5	do	10	300	Do.
Palawan (reports from 3 towns):					
Rice		do		4,500	Do.
Abacá		do			
Coconuts		do			
Sugar cane		do			
Pampanga (reports from 7 towns):					
Rice	220	do	50	90	Do.
Sugar cane		do			
Corn		do	100	1,040	Do.
Pangasinan (reports from 29 towns):					
Rice	11,246	do	741	8,842	Do.
Coconuts		do		156,000	Nuts.
Sugar cane		do	39		
Corn	90	do	71	532	Cavans.
Rizal (reports from 11 towns):					
Rice	828	Fair	10	172	Do.
Abacá		Good			
Sugar cane	9	do			
Corn	6	do	604	684	Do.
Samar (reports from 16 towns):					
Abacá	1,040	Poor	1,309	4,120	Piculs.
Rice		do	186		
Coconuts		Fair		227,630	Nuts.
Sugar cane	12	do	10	150	Piculs.
Sorsogon (reports from 14 towns):					
Abacá	37	do	28,787	9,597	Do.
Coconuts		do		107,000	Nuts.
Sugar cane	8	do	57	3,013	Piculs.
Corn	47	Good	274	1,233	Cavans.
Tarlac (reports from 8 towns):					
Rice	2,226	do	250	4,130	Do.
Sugar cane	94	Excellent			
Coconuts		Good			
Corn	20	do			
Tayabas (reports from 16 towns):					
Rice	43	Fair			
Abacá	4,051	Good	307	1,499	Piculs.
Coconuts		Fair		1,784,400	Nuts.
Corn	11	do	71	166	Cavans.
Zambales (reports from 6 towns):					
Rice	72	Good	25	375	Do.
Coconuts		do		3,000	Nuts.
Sugar cane		do			
Maguey		Fair			

RANGE OF PRICES OF PHILIPPINE AGRICULTURAL PRODUCTS.

Highest, lowest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the months of August and September, 1908.

Province.	Rice, unhulled, per cavan.			Abacá, per picul.			Copra, per picul.		
	High-est.	Lowest.	Aver-age.	High-est.	Lowest.	Aver-age.	High-est.	Lowest.	Aver-age.
Agusan	₱3.50	₱3.00	₱3.25	₱9.00	₱7.00	₱8.00	-------	-------	-------
Albay	3.60	2.50	3.05	9.50	5.00	7.25	₱7.00	₱2.50	₱4.75
Ambos Camarines	3.50	2.50	3.00	15.50	4.00	9.75	7.50	3.00	5.25
Antique	3.12	2.00	2.56	25.00	6.00	15.50	6.50	6.00	6.25
Bataan	3.00	1.80	2.40	-------	-------	-------	-------	-------	-------
Batangas	3.75	2.50	3.12	18.00	13.00	15.50	-------	-------	-------
Benguet	5.00	3.00	4.00	-------	-------	-------	-------	-------	-------
Bohol	3.75	2.00	2.87	16.00	5.00	10.50	7.80	3.00	5.40
Bulacan	3.10	2.00	2.55	-------	-------	-------	-------	-------	-------
Cagayan	3.75	2.50	3.12	-------	-------	-------	7.00	6.00	6.50
Capiz	3.75	1.75	2.75	21.00	7.00	14.00	7.00	3.00	5.00
Cavite	3.25	2.50	2.87	17.87	13.00	15.43	-------	-------	-------
Cebu	3.50	2.00	2.75	18.00	9.00	13.50	8.50	6.00	7.25
Ilocos Norte	4.00	3.25	3.62	-------	-------	-------	-------	-------	-------
Ilocos Sur	3.75	2.25	3.00	-------	-------	-------	-------	-------	-------
Iloilo	3.60	2.50	3.05	22.00	18.00	20.00	7.00	3.00	5.00
Isabela	3.75	3.75	3.75	-------	-------	-------	-------	-------	-------
La Laguna	3.10	2.25	2.67	16.00	5.00	10.50	6.00	4.80	5.40
La Union	4.00	2.00	3.00	-------	-------	-------	8.00	6.25	7.12
Lepanto-Bontoc	4.00	2.50	3.25	-------	-------	-------	3.00	3.00	3.00
Leyte	3.50	2.75	3.12	15.00	6.00	10.50	7.50	4.00	5.75
Mindoro	3.00	1.75	2.37	12.00	10.00	11.00	6.00	4.50	5.25
Misamis	3.75	2.00	2.87	16.50	6.50	11.50	7.00	6.00	6.50
Moro	3.00	2.50	2.75	14.00	6.10	10.05	7.00	5.00	6.00
Nueva Ecija	3.00	1.50	2.25	-------	-------	-------	-------	-------	-------
Nueva Vizcaya	2.50	2.50	2.50	-------	-------	-------	-------	-------	-------
Occidental Negros	3.50	2.50	3.00	22.00	9.50	15.75	6.90	5.00	5.95
Oriental Negros	3.50	2.50	3.00	18.00	6.00	12.00	7.60	6.00	6.80
Palawan	3.00	1.50	2.25	-------	-------	-------	5.50	5.00	5.25
Pampanga	3.00	2.25	2.62	-------	-------	-------	7.00	7.00	7.00
Pangasinan	3.75	2.00	2.87	-------	-------	-------	8.00	2.50	5.25
Rizal	3.00	2.40	2.70	-------	-------	-------	-------	-------	-------
Samar	3.75	2.50	3.62	14.00	9.00	11.50	6.75	5.25	6.00
Sorsogon	3.25	2.00	2.62	16.00	5.50	10.75	7.00	4.50	5.75
Surigao	2.60	2.50	2.55	13.50	10.50	12.00	6.50	5.50	6.00
Tarlac	3.12	2.00	2.56	-------	-------	-------	-------	-------	-------
Tayabas	3.00	2.00	2.50	18.00	4.00	11.00	6.00	3.50	4.75
Zambales	3.12	1.75	2.43	-------	-------	-------	4.00	4.00	4.00

Highest, lowest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the months of August and September, 1908—Continued.

Province.	Sugar, per picul.			Tobacco, per quintal.			Corn, per cavan.		
	Highest.	Lowest.	Average.	Highest.	Lowest	Average.	Highest.	Lowest.	Average.
Agusan	------	------	------	------	------	------	₱1.50	₱1.00	₱1.25
Albay	₱8.00	₱6.00	₱7.00	------	------	------	5.00	2.00	3.50
Ambos Camarines	5.00	5.00	5.00	------	------	------	5.00	1.50	3.25
Antique	2.50	2.00	2.25	₱22.00	₱6.00	₱14.00	2.50	1.50	2.00
Bataan	4.00	3.50	3.75	------	------	------	3.00	1.50	2.25
Batangas	5.00	4.00	4.50	15.00	15.00	15.00	3.00	2.00	2.50
Benguet	5.00	3.00	4.00	------	------	------	4.00	2.50	3.25
Bohol	7.00	3.00	5.00	15.00	3.12	9.06	5.00	1.00	3.00
Bulacan	5.50	4.00	4.75	15.00	10.00	12.50	2.50	1.50	2.00
Cagayan	8.50	3.00	5.75	15.00	6.00	10.50	3.50	1.25	2.37
Capiz	6.00	5.00	5.50	16.00	6.00	11.00	2.60	1.00	1.80
Cavite	7.00	2.50	4.75	------	------	------	2.25	1.25	1.75
Cebu	8.00	2.00	5.00	32.00	3.00	17.50	4.00	1.00	2.50
Ilocos Norte	5.00	5.00	5.00	19.00	8.00	13.50	5.00	1.75	3.37
Ilocos Sur	5.00	3.50	4.25	5.50	3.00	4.25	5.00	2.25	3.62
Iloilo	6.00	4.00	5.00	30.00	5.00	17.50	4.00	2.00	3.00
Isabela	------	------	------	14.00	14.00	14.00	2.50	2.50	2.50
La Laguna	7.50	3.50	5.50	------	------	------	5.00	2.00	3.50
La Union	7.50	2.50	5.00	9.00	4.00	6.50	4.50	1.00	2.75
Lepanto-Bontoc	2.50	2.50	2.50	6.00	4.00	5.00	5.00	3.00	4.00
Leyte	6.00	3.50	4.75	30.00	10.00	20.00	4.00	2.00	3.00
Misamis	4.00	4.00	4.00	18.00	14.00	16.00	3.50	1.50	2.50
Moro	8.00	5.25	6.62	------	------	------	3.00	2.00	2.50
Nueva Ecija	8.00	5.50	6.75	32.00	2.00	17.00	5.00	1.25	3.12
Nueva Vizcaya	------	------	------	32.00	32.00	32.00	1.50	1.50	1.50
Occidental Negros	5.00	3.00	4.00	30.00	4.00	17.00	2.80	1.50	2.15
Oriental Negros	5.00	3.50	4.25	25.00	3.50	14.25	5.00	2.00	3.50
Palawan	------	------	------	20.00	20.00	20.00	------	------	------
Pampanga	6.00	3.40	4.70	------	------	------	2.50	1.25	1.87
Pangasinan	7.00	2.50	4.75	25.00	2.00	13.50	5.00	1.00	3.00
Rizal	7.00	3.00	5.00	------	------	------	5.00	1.50	3.25
Samar	7.00	3.00	5.00	30.00	6.00	18.00	3.00	2.00	2.50
Sorsogon	6.00	2.00	4.00	12.50	8.00	10.25	5.00	1.50	3.25
Tarlac	5.00	4.00	4.50	8.00	6.55	7.27	3.75	2.00	2.87
Tayabas	6.25	4.00	5.12	8.00	5.00	6.50	4.00	1.25	2.62
Zambales	6.25	6.25	6.25	------	------	------	------	------	------

VOL. I NOVEMBER, 1908 No. 11

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Bureau of Agriculture.

SEED AND PLANT DISTRIBUTION.

MAGUEY PLANTS.

Maguey plants will be distributed free of charge to parties requesting them, for their own use, as follows:

200 Hawaiian sucker plants, or
400 native sucker plants.

Parties wishing larger quantities will be required to pay for them at the following rates:

	Per 1,000.
Hawaiian sucker plants	₱10.00
Native sucker plants	6.00

Parties ordering plants not on the free list should send post-office money order for the amount of purchase.

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KAPOK.

The Bureau of Agriculture now has a large supply of *Kapok* seedlings, which will be distributed without charge to persons making application for the same. Applications should be made at once so that the trees can be set out before the close of the present rainy season.

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Roots of this valuable forage plant will be furnished upon application. Guinea grass requires a rather high temperature, plenty of sunshine, and a soil that while moist is not too wet. Unless planted in a well-drained soil, the roots of this grass should not be set out until near the end of the rainy season.

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Applicants for seeds or plants are requested to write name and address clearly, and to give full shipping directions for any material that can not be sent by mail. All communications should be addressed to the Director, Bureau of Agriculture, Manila, Philippine Islands.

G. E. NESOM, *Director of Agriculture.*

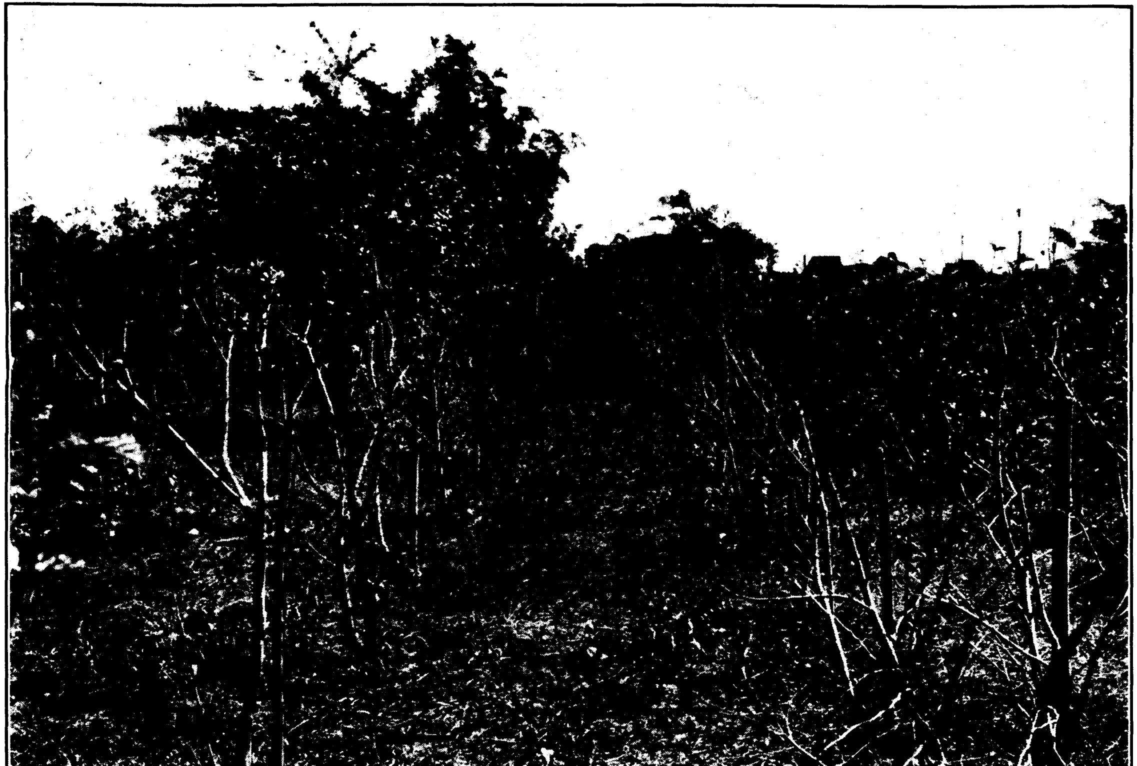

PLATE I.

THE PHILIPPINE
Agricultural Review

VOL. I NOVEMBER, 1908 No. 11

CONTENTS AND ILLUSTRATION.

CONTENTS.

ILLUSTRATION.

EDITORIAL.

VETERINARY WORK OF THE BUREAU OF AGRICULTURE.

We are continuing in this number of the REVIEW the proceedings of the Philippine Veterinary Medical Association. We also include General Order No. 13 of the Bureau of Agriculture, and an article entitled "Koch on rinderpest in the Philippines." In these two articles the attitude of the Government with reference to infective animal diseases is more clearly set forth than it has ever been before. There is a definite determination to suppress them completely and promptly. Nothing short of finally eradicating surra, rinderpest, and foot-and-mouth disease will give the desired results. The American Government in the Philippines has constantly followed up this subject since the earliest days of the civil régime. More than six years ago a veterinary force was employed and the study of the infective animal diseases in these Islands was undertaken. In the course of the work serum was manufactured, and inoculation practiced throughout the Islands. Quarantines were instituted and a general effort was made to interest the local officials and

communities in preventing the spread of animal diseases. The work was more or less unsettled at the beginning as the lines of procedure had to be worked out in the provinces. Some changes were necessary from time to time during the first three years. This formative period of the work has long since passed and it is now thoroughly organized with definite plans which are certain to give results if persistently followed.

The first thing done was to inspect imported cattle to determine whether or not they had infective diseases on arrival. The records show clearly that a great many of them did bring such diseases, especially from China.

The next step was to inspect those cattle being shipped from ports of entry, especially Manila, to the provinces, and determine whether or not they left these ports in a healthy condition. It was found that many of them carried the diseases to the provinces.

It was also found that where diseases prevailed in the provinces they were spread extensively by local cattle trading.

The result of all these studies and observations was to define the different lines of action which are known to be necessary in the suppression of the diseases. The first of these was to establish a rigid inspection and limit the movements of cattle by means of quarantine. The first effort in this direction was the enforcement of the veterinary section of the Sanitary Code of the City of Manila, which became effective January 1, 1907. This law was held in suspension for some months, but in due course of time the quarantine of imported cattle exposed to infective diseases was undertaken. This led to immediate and strong opposition by certain local cattle dealers. They even questioned the integrity of the Government officials who had charge of enforcing the quarantine. All of this agitation led to a full discussion of the subject, which finally resulted in the passage of Act No. 1760 of the Philippine Commission on October 12, 1907. This in effect extended the quarantine to infected and exposed animals throughout the Islands.

Strong protests against all quarantines were constantly made on the ground that the liberal importation of cattle for draft purposes was necessary to replace those which had died from diseases in the provinces. It was shown in the May REVIEW that 90 per cent of the cattle imported into the Islands come to Manila, that 70 per cent of these are slaughtered in this city and 80 per cent of the remainder, shipped to the provinces, are subsequently slaughtered in the towns near Manila. So this argument lost much of its force. If it were not for prejudice, seven pounds of meat out of every ten produced here by imported cattle could as well be bought from cold storage.

After considerable agitation, General Order No. 9 was issued April 30, 1908. Its main feature was to exclude cattle from the infected

places throughout the Orient. This order met with strong opposition from the cattle dealers, and its enforcement was suspended on technical grounds.

General Order No. 10 was issued and provided a system of automatic limitation of shipments from infected places. It gave dealers time to ship cattle which they claimed to have on hand and permitted three successive infected shipments to be landed. However, certain unscrupulous dealers began deliberately importing infected animals from different Chinese ports, changing when three shipments had been made from each.

This was followed by the issuance of General Order No. 12 which put all ports on the same basis in so far as landing of infective shipments is concerned. Under these provisions when an infected shipment of cattle arrives in Manila, the animals can be landed for immediate slaughter only.

This order is the most important step yet taken by the Government in preventing the constant reinfection of different parts of these Islands with rinderpest and foot-and-mouth disease. It marks a distinct epoch in the history of the veterinary work which all thinking men who understand this problem will readily appreciate.

The order in itself is not complete, in that it does not provide details for the cleaning and disinfection of ships, corrals, and other places from which the infection of these diseases is liable to spread. An attempt has been made to remedy this by the codification of all general orders from No. 10 and including the rules and regulations for disinfecting. This constitutes General Order No. 13, published in this number of the REVIEW.

There are three more logical steps which the Government should, and no doubt will, take in due course of time. The first of these is to provide a means of handling infected shipments of carabaos and selected breeding cattle which are not intended for slaughter. This would be simple if there was an island in Manila Bay on which they could be landed. The question is now under consideration, and efforts will be made to settle it as soon as possible.

The second is to exclude entirely all shipments containing infected animals. This action is not absolutely essential now, as cattle can be landed under certain restrictions and immediately slaughtered without spreading diseases; but the exclusion of infected shipments would deter importers from buying cattle at infected ports, and place a premium on importations free from the diseases which we have been fighting so many years. A shipment from an infected port, found to be free from disease on arrival and permitted to land is much more dangerous in spreading diseases than the infected shipment landed for immediate slaughter only.

The one is alive and in contact with native cattle, to which disease will spread if it develops; while the other is dead and beyond the possibility of spreading disease.

The next would be the complete exclusion of all animals from ports or places known to be infected. While this step is not justified at the present time, it will ultimately prove an absolute necessity. It can be done just as soon as it becomes certain that an abundant supply of cattle and carabao, to meet all our demands, can be had from ports which are known to be free from diseases, and from which infected shipments will never come. The only safe course is to make sure that the animals of these Islands will have no chance to become infected, and the only certain way of guaranteeing them against the further invasion of infective animal diseases is to completely exclude all animals from all ports and countries in which infective diseases exist or are liable to prevail.

THE CARNIVAL.

Elsewhere in this number we are printing a premium list of the Philippine Carnival Association. The 1909 Carnival will be held from February 2 to 16, inclusive. The Carnival held from February 27 to March 3, 1908, inclusive, was a marked success.

Every effort is being made to make the next Carnival much better than the last one, which will be difficult to do. Active preparations are being made, the grounds are being inclosed, buildings erected, and the grand stand for the hippodrome will be constructed in the near future.

In the editorial which appeared in the February number of the REVIEW it was predicted that the Carnival would be a success and that in due course of time it would become a great industrial exposition which would include exhibits of the commerce, industry, agriculture and arts, besides the features purely for amusing the visitors.

The REVIEW is particularly interested in the agricultural exhibits, and urges the people of the Islands to lend their aid in making this part of the Carnival a magnificent success. The good example set by La Laguna Province at the last Carnival was an object lesson which should be emulated.

Visitors to Manila during the Carnival will see people from all other parts of the Islands in a carnival mood and are assured that the visit will prove one never to be forgotten.

GENERAL ORDER NO. 13.

CODIFICATION OF RULES AND REGULATIONS FOR THE INSPECTION AND SHIPMENT OF LIVE STOCK.

GENERAL ORDER No. 13. } BUREAU OF AGRICULTURE, *Manila, December 10, 1908.*

[NOTICE.—These rules and regulations are based on Act No. 1760 of the Philippine Commission. Copies of this Act in English or Spanish will be furnished by the Director of Agriculture to anyone making application for the same, either by letter or in person, at the Office of the Bureau of Agriculture, Oriente Building, Manila.]

IMPORTATION AND QUARANTINE.

1. Except as hereinafter provided, all domestic animals, as defined in section 1 of Act No. 1760, imported into the Philippine Islands from other countries where dangerous communicable animal diseases are known to exist, and en route to these Islands for a period of less than ten days, shall if free from disease on arrival be allowed to land, and shall be subject to a total quarantine of not less than ten days from the date of embarkation at the port of origin.

2. Animals imported from ports or places where dangerous communicable animal diseases were not prevalent at the time of embarkation, and found to be free from such diseases on arrival, may be transhipped or landed and transported to any place in the Philippine Islands where the Bureau of Agriculture maintains a system of veterinary inspection or is prepared to establish a temporary system, and there undergo the remaining portion of the quarantine provided in rule 1.

3. Nothing in this or in any other of these rules shall be construed as prohibiting the slaughter for meat of cattle held in quarantine when they are in good health, or as requiring the Director of Agriculture to liberate any animals at the expiration of the ten days' quarantine, if in his judgment dangerous communicable animal diseases are liable to be spread to other points in the Philippine Islands by permitting the shipment of such animals beyond the port of entry at the expiration of the quarantine period.

4. In addition to the quarantine provided for in the first of these rules, animals actually suffering from any of the dangerous communicable diseases defined in section 2 of Act No. 1760 will be held in quaran-

tine until they have recovered, died, or have been slaughtered. Other susceptible animals exposed to the infection of such diseases, or shipped from places declared by the Secretary of the Interior to be infected, will be in quarantine for the following periods after last exposure:

Disease:	
Foot-and-mouth disease Rinderpest	7 days.
Hemorrhagic septicemia Hog cholera	8 days.
All other diseases	10 days.

5. Until such time as the Bureau of Agriculture may be able to provide corrals and sheds in which to keep such animals during the period of quarantine, they shall be quarantined in suitable corrals or sheds to be provided by their owners or agents who shall also furnish suitable attendance, food, and water for animals undergoing quarantine. In case of failure of the owners or agents to furnish these or when animals are placed in Government corrals to undergo quarantine they will be furnished by the Bureau of Agriculture and the owners or agents required to pay for same before the animals are released.

6. Domestic animals once placed in a given corral to undergo quarantine shall not be removed from that corral except with the written permission of the Director of Agriculture or his authorized representative. Certificates for shipments outside of the city limits of the port or city in which the animals are held in quarantine shall be regarded as permission to remove the animals from quarantine for shipment only.

IMPORTATION OF DISEASED CATTLE PROHIBITED.

7. Whenever any domestic animals, as defined in section 1 of Act No. 1760, arrive in a port of the Philippine Islands from any foreign port and are found to be infected with or exposed to any dangerous communicable disease, as defined in section 2 of Act No. 1760, such animals will be prohibited from landing except as hereinafter provided.

8. Imported animals found to be infected with or exposed to anthrax, on arrival in any port of the Philippine Islands, will not be allowed to land, but must be taken, with all effects pertaining to them, beyond the jurisdiction of the Philippine Islands.

LANDING FOR IMMEDIATE SLAUGHTER IN MANILA.

9. Whenever any domestic animals, arriving at the port of Manila from any port, are found to be infected with rinderpest or foot-and-mouth disease, the Director of Agriculture will grant special permission for the discharge of any or all of such animals from the vessel or vessels on which they arrive into suitable vessels or lighters on which they may be held at the port of Manila, under the supervision of an authorized representative of the Director of Agriculture, until such time as they may be exported or slaughtered as hereinafter provided.

10. Any vessel or lighter or any other form of water craft to which animals are transferred, as provided for in rule 9, will be regarded as a quarantine corral and subject to the rules and regulations governing the same: *Provided,* That no animals held in quarantine on such vessel, lighter, or water craft will be permitted to land, except for immediate slaughter, until the expiration of ten days.

11. The Director of Agriculture will allow animals so held in quarantine at the port of Manila to be landed at a point designated by him, as near as practicable to the municipal slaughterhouse, and to be conducted by the shortest practicable route, to be approved by him, into such slaughterhouse and to be killed immediately. The carcasses of such of them as are diseased and are unfit for human food at the time they are killed must be immediately transported to the city crematory and burned.

12. The Director of Agriculture will refuse to permit the transfer from the ship or vessel on which they arrive at the port of Manila to any other vessel, lighter, or other form of water craft, or to the shore, of all animals hopelessly ill with any dangerous communicable disease or suffering from such disease to such an extent as to render them unfit for human food: *Provided,* That the Director of Agriculture will, in his discretion, authorize the killing of such animals on the ship or lighter and their immediate transfer to the crematory where they must be immediately burned.

13. Landing privileges similar to those authorized in rules 9, 10, 11, and 12, will be extended to animals arriving at other ports of entry in the Philippine Islands, whenever such ports provide suitable slaughterhouses, approved by the Director of Agriculture, in which animals may be conveniently landed and killed without danger of spreading infection.

LANDING PERMITS AND SHIPPING CERTIFICATES.

14. All domestic animals as defined in section 1 of Act No. 1760 which are shipped, driven, or otherwise brought into the ports or municipal limits of Manila, Iloilo, Cebu, and other ports or places where systems of veterinary inspection are maintained, shall be subject to inspection by an authorized representative of the Bureau of Agriculture. Shipments arriving by water and rail shall not be landed or discharged until they have been inspected and a permit issued therefor. Animals arriving in these places overland shall be brought at once to a place designated by the Director of Agriculture for the inspection of such animals.

15. Landing and discharging permits are considered as giving permission for the landing or discharging of the animals therein enumerated only within the city limits of the port or place where the permit is issued unless otherwise stated in writing on the face of the permit.

16. No domestic animals, except those which are free from disease

and actually employed at the time in road or field work, shall be shipped, driven, or otherwise taken out of the city or municipal limits of Manila, Iloilo, Cebu, or other places where the Bureau of Agriculture maintains systems of veterinary inspection unless such shipments are accompanied by certificates issued by authority of the Director of Agriculture, stating that the animals to be so shipped, driven or taken have been examined and found free from dangerous communicable diseases. The discharge of domestic animals accompanied by such certificates at ports or places other than those specified in each certificate is prohibited.

17. Shipping certificates are not required to accompany shipments of domestic animals made from one interisland point to another where the Bureau of Agriculture does not maintain a system of veterinary inspection: *Provided,* That the animals so shipped are free from infective diseases and the ship or railway car used in transporting them has been cleaned and disinfected subsequent to handling infected shipments.

18. Landing or discharging permits are not required at ports or places where the Bureau of Agriculture does not maintain systems of veterinary inspection.

SHIPMENTS FROM INFECTED POINTS LIMITED.

19. Hereafter so long as any place is declared by the Secretary of the Interior to be infected with any dangerous communicable animal disease, permits for the shipment of domestic animals from such place, to other infected ports or places in the Philippine Islands, will not be issued except when such animals are destined to a port or place within the Philippine Islands where the Bureau of Agriculture maintains a system of veterinary inspection or is prepared to establish such a system, or where a general outbreak of the same disease exists.

20. The Director of Agriculture will establish and maintain systems of veterinary inspection, so far as the force of employees at his command will permit at any place in the Philippine Islands, upon presentation of satisfactory evidence that the number of animals to be shipped to such place from ports or places declared to be infected with dangerous communicable animal diseases is sufficient to justify him in so doing.

DISINFECTION OF CORRALS, VESSELS, AND CARS.

21. Whenever a corral has been used for the storage of animals suffering from or infected with dangerous communicable diseases, the Director of Agriculture may prohibit its use thereafter for the storage of animals susceptible to such diseases, until it has been cleaned and disinfected in a manner satisfactory to him.

22. All ships, lighters, cascoes, or other forms of water craft, and all railway cars, which have been used in the transportation of diseased animals must be disinfected, and a certificate of such disinfection

secured before the same are again used for the transportation of domestic animals. Masters, owners, and agents of ships and railways, who fail or refuse to comply with this rule subject themselves to prosecution for violation of the provisions of Act No. 1760.

23. Whenever vessels arriving in Manila, Iloilo and Cebu, from foreign ports require disinfection, the masters, owners, or agents, should make application for same in writing to the chief quarantine officer. Such vessels arriving in Manila will be disinfected free of charge at Mariveles.

24. In the ports of Manila, Iloilo and Cebu, owners or agents of ships, lighters, cascoes or other water craft, and railway cars used for the transportation of domestic animals, which require disinfecting may have this work done by making application in writing to the Director of Health or district health officer as the case may be, at least five hours before the same is required.

25. All decks, floors, and other parts of ships or cars which are to be disinfected must be cleaned from all accumulated litter and washed either with salt or fresh water prior to the hour at which disinfection is to be given.

26. Whenever it becomes necessary to disinfect any ship or railway car at any other point in the Philippine Islands, the owner or agent may perform the work and secure a certificate of disinfection from the local health officer. Such certificates must state the methods of disinfection and will be accepted by the Director of Agriculture as valid only when the methods used are thorough and effective.

27. The Director of Agriculture or his authorized representative who has charge of the inspection of any domestic animals for landing or shipment, is empowered to prohibit the use of any ship, lighter, casco or other water craft, or any railway car for the transportation of such animals whenever in his opinion such vessel or car is infected with dangerous communicable animal diseases.

GANG PLANKS REQUIRED.

28. All interisland vessels carrying domestic animals which tie up or anchor alongside of wharfs, docks, or river walls, shall provide and place for use on such wharf, dock, or river wall, suitable gang planks or runways for loading or discharging such animals, guarded on both sides by rails or other devices which will prevent the animals from falling overboard while being loaded or discharged over such gang planks or runways. The animals may be loaded or discharged into or out of other vessels at the option of the owner or agent, if the laws, rules and regulations for the shipment of domestic animals are otherwise complied with.

CERTAIN CLASSES OF ANIMALS EXEMPT.

29. Animals which have been permanently immunized against rinderpest, or have had rinderpest and recovered from it, when accompanied by a certificate, issued by authority of the Director of Agriculture to this effect, and in which the marks and brands are so given as to enable one positively to identify each individual animal, shall not be subject to quarantine on account of rinderpest.

30. Animals imported from countries where dangerous communicable animal diseases do not exist and are found to be free from such diseases on arrival, may be transhipped without landing and transported to any part of the Philippine Islands.

31. Animals actually employed in road or field work may be allowed to leave and enter any city, municipality, province, township or settlement where dangerous communicable animal diseases have been declared by the Secretary of the Interior to exist, whenever in the opinion of the Director of Agriculture they can be permitted to do so without danger of contracting and spreading such diseases, and under such rules as he may prescribe.

32. Native cattle shipped from one port or place to another within the Philippine Islands, when free from dangerous communicable animal diseases, and so handled as in the opinion of the Director of Agriculture to prevent them from contracting and spreading such diseases, shall not be required to be certified by the Director of Agriculture, except when shipped from ports or places where the Bureau of Agriculture maintains systems of veterinary inspection.

33. This codification of rules and regulations embodies and supersedes General Orders Nos. 10, 11 and 12, and shall take effect on February 1, 1909.

G. E. NESOM,
Director of Agriculture.

Approved:
DEAN C. WORCESTER, *Secretary of the Interior.*

KOCH ON RINDERPEST IN THE PHILIPPINES.

By G. E. NESOM, *Director of Agriculture.*

Dr. Robert Koch is looked upon as the leading authority on many questions of human and veterinary medicine. Among other accomplishments he has made a thorough study of rinderpest in South Africa and Egypt. The results of his studies and investigations have had a marked influence in the work of controlling this disease throughout the civilized world. His method for the manufacture of serum was adopted in the Philippines by the Bureau of Science in the year 1902, and was used with but few modifications until January 1, 1907.

Dr. Koch has been called upon to give advice in the control of many diseases and his recent studies in South Africa on sleeping sickness have added further to his already world-wide reputation. On his visit to the United States prior to embarking for the Orient, great interest was shown in him and his work. He was given ovations throughout the country and on reaching the Orient every inducement was offered him to visit all parts of the Far East. The following invitation was sent through the American ambassador, Tokyo, under date of July 16, 1908: "The Governor-General of the Philippine Islands most cordially and earnestly invites you to visit the Philippine Islands while in the Far East. We think you will be interested in our scientific work in the study of tropical diseases. Your acceptance of this invitation will be exceedingly gratifying to this government." On July 20, a reply came in which Dr. Koch expressed deepest regret that he was unable to accept the invitation as he was compelled to shorten his visit and proceed directly from Japan to Germany.

These Islands have thereby missed the benefit of the scientific advice and the inspiration which a visit from him would have given to the work of controlling human and animal diseases here. It is particularly unfortunate that he could not come at a time when cholera was rather widespread and when the greatest efforts were being made to place rinderpest under control.

Dr. Koch subsequently returned to the United States and attended the International Tuberculosis Congress held in Washington, D. C., last September. While there he was seen by the Director of Health of the Phil-

ippine Islands who discussed with him many topics of interest pertaining to the health of man and the domestic animals in the Philippines.

Among the topics considered was the possibility of placing rinderpest in these Islands under control. Dr. Koch expresses the opinion that the Government should undertake serum inoculation on an extensive scale. He thinks the work should begin in Manila, that all cattle received from foreign countries and those in communities where rinderpest exists, should be given serum inoculation. He thinks we should organize a good service for the detection of new cases throughout the Islands, so as to make sure that when eradication is undertaken in a single island it will be thoroughly covered by this service, all centers of infection located, and the spread of the disease prevented. He says that under this system no animals need be sacrificed, that the methods will soon become very popular and that if inaugurated on a sufficient scale to cover the Archipelago and the work done thoroughly, it is possible to place rinderpest under control within one year. He specifically condemns the use of the simultaneous method in the provinces.

It is of interest to note that all investigators who have had occasion to work in the control of rinderpest for any considerable time have reached practically uniform conclusions as to the methods to be used. Some of the officials who have been continuously in touch with the rinderpest control work in these Islands for five or six or even eight years are fully convinced that Dr. Koch is quite right in many of his conclusions. A brief statement of the methods now in use here and the history of changes made in them will show how closely they correspond to the ideas expressed by Dr. Koch.

Serum inoculation has been extensively practiced by the Bureau of Agriculture for more than three years and has given excellent satisfaction. Briefly stated, the method is to begin inoculating with serum at each center of infection and spread out in continuous circles in lines of travel where animals are not thoroughly quarantined so as to temporarily immunize all animals which are liable to be exposed to infection. Ordinarily it is not necessary to reinoculate any of these animals once given serum, as most outbreaks can be easily suppressed by a little concentrated effort on the part of the veterinary force with local police aid, before animals lose their temporary immunity.

Persistent efforts have been made to bring this question to the attention of local provincial and municipal officials with a view to securing prompt reports of outbreaks and quarantine pending arrival of a veterinarian. Repeated appeals have been made by letters, circulars, press notices in the Spanish papers and through the columns of the PHILIPPINE AGRICULTURAL REVIEW. The REVIEW for March is entirely devoted to this subject and articles have since appeared frequently, such as those in the May and October numbers. The urgent importance of a campaign,

the ultimate object of which should be the complete eradication of infective animal diseases, has been the subject of several editorials. All this has resulted in an appreciable increase in both private and official interest in this all important question. Further legislation and executive orders would greatly strengthen this branch of the work.

Dr. Koch's opinion as to the use of the simultaneous method for permanently immunizing animals against this disease is supported fully by the experiences here. It was discovered some years ago that this method had some very serious defects which render its general use in the provinces impracticable. It was however, continued until November 1, 1905, at which time the veterinary division was transferred from the Bureau of Health to the Bureau of Agriculture. Then the former orders requiring veterinarians to give simultaneous inoculation in the provinces, were revoked and serum inoculation substituted. The popular objections to simultaneous inoculation were the abnormal death rate which so frequently results when animals are not given proper care, which often occurs in the provinces. It renders all of the animals inoculated unfit for service for a period of from ten to twenty days, there is a possibility of spreading infection from the animals so inoculated, and expense incident to this process is quite heavy. Besides, if the disease is effectually placed under control there is no inducement to have animals immunized as they will have no opportunity to come into contact with the infection.

These general conclusions were drawn by Dr. Koch from his experiences in South Africa and Egypt where conditions vary widely from those in the Philippines. They were likewise evolved here after many years of patient toil. In a sense they were universal and under similar conditions would give uniform results.

The conditions prevailing here influence the introduction, spread, persistence, and control of this disease. Some of these conditions are naturally adverse and not amenable to change, while others are naturally favorable and act as self-limiting agents in the spread of this disease.

Among the uncontrollable adverse conditions are the location, topography, and climatic conditions. These Islands are wholly within the tropics as well as near China and the colonies of the Orient where rinderpest has apparently a firm footing, from which it can scarcely be dislodged within this generation. The topography of the Philippines presents two extremes. Most of the islands have a rugged backbone of mountains which drop off suddenly into a level coastal plain. Under present conditions most parts of the mountains are reached only by trails. In the lowlands during the rainy season transportation is very difficult on account of swollen streams, poor roads, and few bridges. While these conditions make the suppression of the disease a hard problem to solve, they also serve as limiting agents in the spread of the disease, by restricting the movements of live stock. Rinderpest is generally much worse in the

rainy than in the dry season. The infection is evidently perpetuated in the bogs and sloughs where carabaos graze and wallow. There is a notable decrease in the disease after the advent of the dry season.

But the real determining factors in this question are legal, financial, industrial, and educational. They appeared as distinctly unfavorable conditions a few years ago, but there has been a gradual, progressive, material change for the better with the march of time. A brief retrospect will reveal many points of interest. Prior to October 12, 1907, there was no Insular law prohibiting the importation of diseased animals. The Provincial and Municipal Codes made it optional with the provincial and municipal boards to establish quarantines and otherwise attempt the control of this and other diseases within their respective jurisdictions. But few of these boards have ever availed themselves of their authority in the control of infective animal diseases except in cases where serious outbreaks have occurred. There have been some cases of provinces grossly infected throughout the barrios of many municipalities and where not a single ordinance, executive order, or police regulation was put into operation to meet existing conditions.

In fact, up to the year 1905, in many parts of the Islands there was active opposition against quarantines of all kinds on the part of many influential people, to say nothing of the ignorant masses. All attempts made by Government officials or individuals, to control the movements of animals infected with this disease proved very unpopular.

The active enforcement of the quarantine law forbidding the importation of diseased animals into the Philippine Islands and restricting their movements after arrival here was not undertaken until June of the current year. Thereafter General Order No. 10 made it possible to continue the infection of these Islands indefinitely by bringing cattle from the different ports of China and Indo-China in accordance with Rule II of that order. Under these conditions it would make little difference whether the Government did or did not suppress the disease in the Islands. It was impossible to control it until the importation of the disease was effectually stopped.

General Order No. 12, issued November 2, 1908, excludes from all ports of these Islands all shipments containing animals infected with or exposed to dangerous communicable diseases. As a business concession, the order provides that healthy animals exposed in an infected shipment, may under certain restrictions, be landed for immediate slaughter only or held on vessels which shall serve as quarantine stations for a period sufficient to determine that the animals will not develop disease after being landed. This is probably the most significant move which has ever been made here in the exclusion of diseases among imported animals.

If this rule is enforced it will effect a condition to which all the efforts to control rinderpest have looked forward. It will leave the

officials free to deal only with the diseases which actually exist here. The last step in this direction has been the codification of all existing rules as General Order No. 13, which is published in this number of the Review.

One of the serious defects in the system used here has been the lack of a sufficient quantity of serum to prosecute the work vigorously in all cases. There has also been a constant scarcity of competent veterinarians, which has often prevented their being sent out to infected places in time to prevent the disease from obtaining a firm foothold. Both of these defects have been effectually remedied. The capacity for the manufacture of serum has been enlarged by the removal of the herd to the new quarters at the Alabang stock farm, and the number of veterinarians employed has been increased. It is almost certain that there will ultimately be an available veterinarian for each of the provinces and principal islands.

Appropriations have been made for the construction and complete equipment of live-stock depots to be used as quarantine stations in the cities of Manila, Iloilo, and Cebu. These will be modern, sanitary places and will replace the very poor corrals now in use by the importers of cattle. It is probable that one or two of these stations will be completed and ready for operation by the middle of the year 1909. As soon as all imported cattle can be discharged into these Government depots and held sufficiently long to make sure that they will not take disease to the provinces when shipped out of the port of entry, a wonderful advance will have been made in the control of rinderpest.

Substantial progress has been made in the control of animal diseases in the Philippines and the country is being rapidly restocked by increase in the native herds. The importation is now almost entirely confined to cattle intended for slaughter in Manila. As soon as there is a local supply of cattle sufficient to meet this demand, the importation from countries in which rinderpest prevails can be discontinued altogether and the work of eradicating this disease in the Philippines limited to handling outbreaks which occur from infection within our borders. This will insure a condition of affairs which should bring general prosperity to the whole country and animal industry can again assume the importance which it had during the decade beginning about 1885.

A great deal of the campaign against this disease has necessarily been of an educational nature. The people in general have had to be taught the importance of the disease which swooped down upon the animal industry of the country without warning and almost destroyed it. They have been helpless, largely because they have not understood its nature, importance, nor how it might be handled. A constant educational campaign has been waged for a number of years, as evidenced by such publications as the catechism on infective animal diseases, published as

Volume I, No. 3, of the PHILIPPINE AGRICULTURAL REVIEW. Our work in this respect, however, is not finished and the campaign will be continued through the medium of publications, the division of extension work, with the aid of teachers in the provinces, and through official channels. The Filipino people as a whole have shown a spirit of indifference toward the efforts to aid them in throwing off this plague and they will no doubt retain this attitude until they are educated along the lines above indicated. This will require time, patience and proper facilities, but it is not a task impossible of accomplishment if it is properly handled.

Those who have been attempting the control of rinderpest in these Islands have had many years of experience which have given them an insight into the conditions regarding the control of this disease here which even Dr. Koch could not possibly possess without visiting here and thoroughly studying the problem in person. He has not been here and this fact constitutes a satisfactory reason for disagreeing with him on some of the points mentioned in his interview.

The conditions as to location, topography and climate are well understood and may be dropped from further consideration. There is a trade condition which demands the importation of cattle from China and Indo-China, principally for slaughter in Manila. Last year almost 70 per cent of the imported cattle received in Manila were slaughtered within the municipal limits of this city within a few days after arrival. The inoculation of this class of cattle alone with a single injection of 50 cubic centimeters of serum would cost the Government or owners about ₱50,000 per annum in serum, services, and expenses. It would certainly be a bad business practice without hope of giving the desired results.

It seems desirable to inoculate all imported cattle shipped to the provinces. However, as 80 per cent of these are slaughtered in the towns near Manila within a few days after shipment and are not allowed to go out of this city except when free from disease, there is some question about the advisability of inoculating them.

The draft animals used for heavy street work in the cities consist almost entirely of carabaos. The percentage of immune animals among these is not known but is probably quite large, as they have for many years had ample opportunity for exposure to the disease but in recent years very few of them appear to contract it. Those which are not already permanently immune by virtue of having had the disease are not liable to come into contact with it if the exclusion of infected animals is rigidly enforced. Even if given antirinderpest serum it would not prove an absolute guarantee against their contracting the disease, as its immunizing value decreases rapidly during a period of three or four months, after which it has but little effect.

Dr. Koch has certainly reached the proper conclusion with reference to the extensive use of serum inoculation in localities where the disease exists. If the available supply of serum is large enough to inoculate liberally around all outbreaks, and thereby temporarily immunize all animals liable to exposure, the results are always excellent. A given amount of serum used in this way yields much better results than could possibly be obtained in corrals of importers or in general provincial inoculations where no rinderpest prevailed at the time.

Another condition which may have much influence on this question is the presence in some parts of the provinces of wild carabao. They are in all essential respects the same as the domestic animal ordinarily used for draft purposes in these Islands and will no doubt contract the disease whenever they are exposed to the infection. Deer are also very common throughout the Archipelago and there are some authentic cases, especially in the mountains of Benguet, where they have contracted and spread the disease to herds of cattle. The instances of this kind which are liable to occur are comparatively few, but may be a final determining factor as to whether or not the disease will be completely eradicated here. If wild carabao and deer prove important agents in carrying the infection, control of the disease may be indefinitely delayed. Such animals can neither be inoculated nor quarantined. The only alternative, in case they prove a serious obstacle, is to wait patiently the slow process of extermination by the disease. In the mean time, it will do much more harm to the domestic than to the wild animals.

In the meager advices received, Dr. Koch does not appear to have mentioned the value of quarantine. This omission was no doubt inadvertent as he is fully aware of its value in dealing with severe infective diseases. As a means to an end, a quarantine that is really effective is more important than any other one measure used here. It includes the exclusion of diseased cattle from foreign countries, holding those allowed to land long enough to make sure they do not take diseases to the provinces, guarding the interisland shipment of diseased animals and promptly isolating infected and exposed animals whenever the disease makes its appearance.

The opinion expressed by Dr. Koch as to the possible time under the most favorable conditions within which the disease might be placed under control is not overdrawn. These conditions however, are practically impossible at the present time. It would be a very optimistic view for those who have the responsibility of placing the disease under control to suppose that the work will be accomplished within one year.

On the contrary there is every indication that it will be a work of several years if the conditions surrounding the work do not materially change.

The restoration of depleted fortunes after a destructive war, the reclaiming of waste lands, the natural increase of the small herds left after the ravages of rinderpest so recently experienced, the building and rebuilding of bridges and roads all require time. Then there is the modernizing of education, agriculture, industry and commerce in an oriental colony which learned its best lessons years ago from a European nation; now in its turn learning anew the same lessons from the more progressive nations of the world.

PROCEEDINGS OF THE PHILIPPINE VETERINARY MEDICAL ASSOCIATION.

[Continued from the October number.]

The morning session of the association on September 29 consisted in part of a visit to the serum laboratory maintained by the Bureau of Agriculture. The assembly of provincial governors being held in Manila at that time visited there the same morning. This meeting was planned to bring into closer touch the provincial governors, and the veterinarians of the Bureau of Agriculture who often have occasion to request the coöperation of the governors by the enactment of ordinances, the enforcement of quarantines, and the executive control of municipal officials.

It gave the governors and veterinarians from the same provinces an opportunity to see the work being done at the serum laboratory and talk over the subject of animal diseases with a better understanding than could be done under ordinary circumstances.

The veterinarian in charge of the serum laboratory had everything in readiness to demonstrate all of the principal processes in the manufacture and use of serum and made a post-mortem examination of a bullock affected with rinderpest. He handed each of the visitors a copy of the following circular:

ANTI-RINDERPEST SERUM.

Anti-rinderpest serum is the liquid portion of the blood of an animal which has had rinderpest and fully recovered. It has the power of fortifying cattle and carabaos against the infection of rinderpest, and when given early, acts as a curative agent to this disease. When used to fortify cattle and carabaos against rinderpest, its power can not be relied upon longer than two or three months. When an animal has had rinderpest and recovered, it will not have this disease any more.

This serum has been known for a number of years in different parts of Europe, and the present methods of obtaining it which have been perfected within the last few years, give the best serum of its kind in the world. The method now in use for obtaining anti-rinderpest serum is very simple. The animals from which the serum is obtained are the most important factor which has to be considered. Immunized cattle are used for this purpose, but immunized carabaos ought to be just as good, if it were possible to put them through the same manipulations

which are required in order to get blood. They ought to be gentle and easy to handle, must be in a healthy condition, and must have recovered from an attack of rinderpest.

To obtain anti-rinderpest serum, the healthy immunized animal is placed on a table where it is securely tied, and from 2 to 4 liters of blood, according to the size of the animal, are taken from the large vein in the neck. The blood is drawn in perfectly sterile flasks or bottles, which are allowed to remain in a dark, cool place for twenty-four hours. At the end of this time at least 40 per cent of the blood drawn will be replaced by an amber-colored fluid floating on top of a very dark gelatinous mass, or the blood-clot. The amber-colored fluid is anti-rinderpest serum. It is poured from the true clot into a larger sterile flask, or bottle, where a weak solution of carbolic acid is added to prevent fermentation in case any germs have gotten into it. Then it is passed through a very fine filter to further remove any bacteria that might be present, as well as particles of blood clot. From this fine filter it passes into sterile 350 cubic centimeter bottles which are labeled "anti-rinderpest serum," packed, and shipped to the provinces for use.

The dose of this serum is from 15 cubic centimeters to 20 cubic centimeters per hundred pounds of live weight, though if given in larger quantities no bad results will follow. The average dose used by the Bureau of Agriculture is 60 cubic centimeters. It is administered with a hypodermic syringe, being injected under the skin in the animal's side. In the past it cost about ₱1.60 per dose.

For the past two years the amount produced was less than what was required to control outbreaks of rinderpest in the provinces, but during the past ninety days the production has so increased that a small surplus is on hand at present.

At a laboratory where anti-rinderpest serum is produced it is necessary to keep on hand a small herd of cattle which are highly susceptible to rinderpest. At least one of these non-immunized animals must carry the infection at all times, so that virulent blood may be obtained in order to keep the serum herd in a high state of immunization. When these highly susceptible animals show unmistakable symptoms of rinderpest, they are bled to death; the blood being injected into the different serum animals.

The attention of visitors to the serum laboratory is invited to the fact that beginning in 1906 plans were made for the removal of the serum herd to a farm outside of Manila. It was fully expected that the buildings could be constructed and the move made by the beginning of 1908. With all the efforts which have been made, the buildings and grounds of the Alabang stock farm, to which the serum herd is to be removed, still require a small amount of work before the herd can be taken there. But it is confidently expected that the move will be

undertaken about the 15th of next month. So, in view of the fact that we have been constantly expecting to abandon the quarters used for this work, repairs and additions have not been made.

A special invitation is extended to the provincial governors and the Government officials to visit and inspect the new laboratory site at Alabang, on the Batangas line of the Manila Railway Company.

At the close of the demonstration at the serum laboratory the members of the association returned to the office of the Bureau of Agriculture where a short literary session was held. The papers which were read at this and the following sessions are not published in the order presented, but have been arranged so as to give an assortment of subjects for each number of the REVIEW in which they appear.

OPSONINS AND THE OPSONIC INDEX.

By Dr. FRANK C. GEARHART.

Immunity in its broadest sense may be defined as "resistance to disease." It can therefore logically be grouped into three divisions: first, natural and relatively absolute immunity; second, acquired immunity; and third, the varying and fluctuating natural immunity possessed by all animals against disease, and usually spoken of, not as immunity, but as resistance to disease enjoyed by the individual to a greater or less degree, depending upon the extent of the predisposing factors involved. During the last decade science has expended a vast amount of energy in endeavoring to ascertain what constituents of the animal economy are responsible for its protection and how and under what conditions they manifest their power.

As early as the middle of the last century Haeckel demonstrated that certain substances injected into the blood stream were taken up by the bloods cells. However, the significance of this fact was not noticed or understood at that time. Later, in 1883, Metchnikoff decided that this fact had a bearing on immunity, and working from this basis established his great and well-known theory of phagocytosis. This marks the beginning of an era of great awakening in medical science. Scientific men have since been studying and investigating the natural protective agents of the body with an ever-increasing interest, and the end is not yet.

After the publishing of Metchnikoff's theory, a score of other theories of immunity, nearly all accrediting the virtue to the blood serum or to the elements contained therein, were carefully worked out and proved to the satisfaction of the adherents of each. Metchnikoff's views were for a time discredited by most students and investigators; in fact, the investigations brought out so many phases and questions that could not be answered by the theory of phagocytosis alone that the author of this theory was forced to acknowledge that there were other forces than the

phagocytes at work in protecting the animal economy against bacterial invasion. After another long series of investigation he modified his theory of phagocytosis somewhat. He still holds that the leucocytes are the direct and essential protectors of the body, but admits that certain other factors govern their activity and efficiency. He holds that the anti-bodies in the blood serum are of value only as they aid the phagocytes in their warfare against the invading bacteria.

In 1903 Sir A. E. Wright, of St. Mary's Hospital, London, demonstrated that certain constant constituents of the blood serum were responsible for the action of the leucocytes in destroying bacteria, and that there is always a direct relation between the health of an individual and the amount of these protective agents in the blood serum. These elements he called "opsonins." The exact nature of these opsonins is not yet understood. Investigators have been too busy studying their powers and actions to take up in an exhaustive manner the subject of opsonins as related only to their chemical nature. It has been shown, however, that they differ from lysins, alexins, agglutinins, hemolysins, and other anti-bodies, and that they will pass through a porcelain filter. A great amount of important work has been done on this subject by other investigators, but Wright has been and is yet the great leader.

It has been proved that the opsonins render their aid by acting on the bacteria and not by stimulating or otherwise influencing the leucocytes. Leucocytes from an immunized animal when placed in a normal serum behave in the same manner toward bacteria as leucocytes from a normal animal. If an emulsion of washed leucocytes and bacteria is placed in a normal salt solution and incubated, little or no phagocytosis takes place, but if a quantity of blood serum be added to a similar mixture of leucocytes and bacteria, marked phagocytosis will be noticed. If the germs are placed in serum for a short time and are then washed to remove the serum and placed in a normal salt solution with leucocytes, the bacteria will at once be ingested. Thus it can be seen that the opsonins act on the bacteria in such a way that they may be taken up and destroyed by the leucocytes. It should not be inferred that the bacteria are killed before they are ingested by the leucocytes, as such is not the case, for animals have been inoculated with leucocytes containing freshly ingested bacteria and the specific disease produced.

The opsonins are specific; that is, there is a special opsonin for each bacteria. Whether or not this holds true for the strains, is yet to be proved. The opsonic power of the blood may be high for one bacteria and low for another. Another proof that the opsonins are specific is that if staphylococci are brought in contact with normal serum and afterwards removed, the serum is found to have lost its opsonic power for staphylococci, but still retains its full opsonic power toward the tubercule bacilus. Also, if an individual is inoculated with tuberculin

the tuberculo-opsonic index is raised, but the index for staphylococcus remains as before.

In order that the term "opsonic index" may be used understandingly in the different phases of this subject which follow, it may be well to speak of it briefly at this time. The opsonic index is the expression in figures of the relative amount of opsonins found in a given blood serum, the amount of opsonins existing under similar conditions in a normal serum being taken as the unit of measure. In determining a patient's opsonic index the following technique is employed: About 20 drops of blood is drawn from the patient and to this is added 20 cubic centimeters of normal salt solution containing 1 per cent of sodium citrate. The mixture is centrifuged and the upper portion of clear serum is removed. The upper layer of the blood cells is transferred to 10 cubic centimeters of normal salt solution and this mixture is again centrifuged and the upper fluid drawn off, the remaining cells being used for the test. One volume of these cells is added to one volume of bacteria and one volume of the patient's serum. These are thoroughly mixed by drawing them into a pipette with a capillary end and expelling the mixture on a slide several times. The mixture is then drawn into the tube, the end sealed in a flame, and the tube with its contents incubated at 37° C. Another tube is prepared at the same time and in a similar manner, except that a normal serum is used. Both tubes are placed in the incubator at exactly the same time and removed together at the end of fifteen minutes. The contents of each tube is now spread on separate slides, dried, and stained in the usual manner. The average number of bacteria ingested by the leucocytes is determined for each slide. This number for the serum to be tested is divided by the number for the normal serum and the result is the opsonic index of the patient. For instance, if the average number of bacteria ingested by the leucocytes on both slides was three, then the opsonic index of the patient would be 1, or normal. If the count for the normal serum slide was four and that of the patient's slide three, then the index would be 0.75, or low. If the normal was three and the patient's four and one-half, then the index would be 1.5, or high.

When no bacterial infection is present, a normal individual exhibits a constant or nearly constant opsonic index when tested for the various bacteria. However, a comparatively normal individual's opsonic index may be lowered for any bacteria by hemorrhage, fatigue, starvation, or severe bodily exertion. In a strictly localized infection due to any micro-organism the individual affected will show a low opsonic index. In general systemic infections the opsonic index will be high, or fluctuating from high to low.

The fact that the opsonic index of patients suffering from local infections is constantly low for the causative organism makes it of great

value in clinical diagnosis. For instance, if in case of an abscess we wish to ascertain the causative agent, the opsonic index of the patient might be taken for streptococcus, staphylococcus, and for the tubercule bacillus. If the index was normal for the first two and low for the tubercule bacillus, we could say with a large measure of accuracy that the affection was of tubercular origin.

The question that interests practitioners most is how the opsonic index may be raised. Only one method of importance has been found and that is being used with great success. This method is known as "opsonic therapy," and consists of the hypodermic injection of specific vaccines. These vaccines differ from the preparations commonly known as vaccines in that they are sterile emulsions of dead bacteria in lysol saline solutions. Wright has shown that these vaccines will raise the opsonic index, and the fact that they are being used almost to the exclusion of other methods by many of the greatest practicing physicians in England and America attests their clinical value. These vaccines can be prepared by any practitioner and may be made from stock cultures, but usually much better results are obtained by the use of cultures from the patient to be treated, as the specific strain is thus secured.

The injection of these vaccines is first followed by a negative phase or a lowering of the opsonic index, but by virtue of their presence in the blood additional opsonins are produced and within a few days a positive phase appears, as evidenced by a rise of the opsonic index and improved clinical symptoms. Because of the initial negative phase only small doses of vaccine should be employed and other doses should not be given until after the positive phase is established.

I think we all realize that with our present methods of ministering to the diseased body we are concerning ourselves more about suppressing the symptoms manifested than in aiding a naturally perfect machine to adjust itself.

Trusting that this poor presentation of a truly important subject has been of some interest to you who have so patiently heard me through, I thank you.

Discussion, Drs. Youngberg, Gearhart, Kretzer, and Thomson.

HOW PARASITES ARE TRANSMITTED.

By J. H. McKinnon, D. V. M.

Animal parasites live in or upon animals and depend upon the latter for nourishment. Since many of the diseases of man and other animals are due to the action of such parasites, a knowledge of these organisms is of great importance from a practical standpoint. Especially important is a knowledge of their histories, since the means of preventing parasitic diseases become apparent only after it is known how the parasites causing

these diseases are transmitted. Every one, therefore, and especially persons interested in the raising of live stock, should know something of the various ways by which these parasites are carried from one animal to another.

It may be stated at the beginning that animals derive their parasites from other animals and that in no case are parasites produced by spontaneous generation; they are always the offspring of ancestors similar to themselves. Such ideas as the origin of lice in filth or the development of intestinal worms from mucus, shreds of meat, horse hairs, straws, etc., have long since been proved entirely wrong. We know that lice come only from other lice, and worms from other worms. There are several hundred known species of parasites in man and the domestic animals, not to speak of thousands of others found in wild animals. They are classified according to their structure in the following groups:

1. A class known to science as Arthropoda. (*a*) Flies and mosquitoes: Mosquitoes and many of the flies are parasitic only when adult; on the other hand, only the larvæ of some flies are parasitic, the adults living entirely free; certain of the blood-sucking flies and mosquitoes are transmitters of other parasites. (*b*) Fleas. (*c*) Lice. (*d*) Ticks: Some species are especially important as the agents by which certain parasites, given below in class five, are transmitted. (*e*) Mites: The most important forms are those which are parasitic on the skin and cause mange and scab. (*f*) Tongueworms, which in spite of their wormlike appearance are related to the tick.

2. A class known as roundworms. These worms are unjointed. The adult forms are found chiefly in organs opening directly to the exterior, such as the alimentary canal, respiratory organs, and urinary organs. Some, however, occur in the connective tissues, in the blood vessels, lymphatics, abdominal cavity, etc. The immature stages of some species are found encysted in various locations—walls of the intestines, liver, etc.

3. A class known as tapeworms. Adult tapeworms are ribbon-like, jointed worms, occurring in the intestinal canal. Bladder worms, which are tapeworms in the immature or larval stage, may be found in almost any organ.

4. A class known as flukes. These worms are usually flat and leaf-shaped, and of different sizes according to the species. They are found chiefly in the stomach, intestines, liver, lungs, and blood, but also in other places.

5. A class known as protozoa. These are small animals which are usually invisible except under a microscope. Parasitic protozoa are the cause of a number of important diseases among the domestic animals, a fact that has been recognized in many cases only very recently. They occur in various organs, but probably the most remarkable are those found in the blood.

Mosquitoes.—The mosquitoes belong in the catalogue of temporary or occasional parasites and are practically free-living animals. Except in a few species, only the female sucks blood, the male living altogether on vegetable juices. As almost everyone knows, mosquitoes propagate by means of eggs laid on the surface of water, and the "wigglers" hatching from these eggs are familiar objects in stagnant pools and rain barrels. The "wigglers" or larvæ transform into pupæ and finally into the matured winged insects, all within a few days.

Flies.—The buffalo gnats and many of the horseflies have a life history very similar to that of the mosquito. The eggs are deposited near water or in moist places and the larval and pupal stages are passed in some cases in water, in others in damp earth. The botflies are insects which are parasitic as larvæ and free-living when mature. Although animals often seem to be much afraid of these flies, the adult never bites and only the larvæ are parasitic. The sheep botfly is the adult of the well-known grub found in the heads of sheep. These insects are met with in the mature stage during the entire warm season from May to October. The female deposits her young, already hatched from the egg, directly in the nostrils of the sheep. The larvæ then crawl up through the nasal passages and finally get into the frontal sinuses, which are located between the two plates of the skull just above the eyes. In this situation they grow and develop during a period of about ten months. At the end of this time they desert the frontal sinuses and travel back through the nose by the way they came. From the nose they are expelled by the sneezing and snorting of the sheep. They then burrow into the ground and pass into a quiescent stage, which lasts about a month or six weeks. The envelope of the pupa is then ruptured and the mature fly comes forth.

The botflies of horses have a life history very similiar to that of the sheep botfly, but slightly more complicated. They deposit their unhatched eggs upon the skin, gluing them to the hairs and usually in regions within reach of the horse's lips and tongue. After a number of days' incubation the eggs hatch and the larvæ are carried by the tongue into the mouth and swallowed. They then attach themselves to the wall of the stomach, duodenum, or rectum, where they remain for several months. Finally loosening their hold, they are carried out of the body in the dung and complete their development in the ground, passing through a pupal stage in the same manner as the sheep botfly.

The grubs known as "warbles," which are common parasites of cattle under the skin of the back, are the larvæ of flies nearly related to the botflies of horses and sheep. The species found in this country deposits its eggs on the hair, chiefly on that around the heels. The cattle in licking themselves carry the eggs into the mouth and after boring through the wall of the gullet the larvæ gradually work their way through the tissues to the back, where they finally show up beneath the

skin, reaching this point usually in the month of January. Here they grow until March, or even as late as May, and then work through the skin and fall to the ground. After a month passed in the ground as pupæ the adult flies come forth.

The hornfly, which is parasitic upon cattle during the adult stage, deposits its eggs in cow manure and the free-living larvæ undergo their development there, descending into the ground when ready to pass into the pupal stage.

Screw flies deposit their eggs in wounds, exposed openings of the body, or decaying matter, three or four hundred at a time. These eggs hatch in a few hours and the larvæ finish their development in about a week, meanwhile doing serious damage to the surrounding tissues. Burrowing into the ground the larvæ transform into pupæ, from which the matured flies emerge in from ten to twelve days. Screw flies differ from botflies in so far as their larvæ are not necessarily parasitic, but may develop in various decaying substances, as well as in living flesh.

The so-called sheep tick is in reality a wingless fly. The method of reproduction is rather unusual in that the eggs hatch and the larvæ develop in the body of the adult as far as the pupal stage. When the pupæ is expelled its case soon becomes hard and glossy, but remains glued to the wool by a sticky substance. The entire life of the sheep tick is unlike that of the other insects so far discussed in that it is a permanent parasite. It is transferred from one sheep to another chiefly by direct contact of the animals and, as a rule, lives only a few days or a week when removed from its host.

The eggs of fleas are scattered by infected animals in various places, especially in their sleeping quarters. Little maggot-like larvæ hatch from the eggs and feed upon the decaying organic matter that they find amid the dust and litter in which they live. In the next stage of development they spin about themselves delicate cocoons and change into pupæ from which the mature fleas finally emerge.

The various kinds of lice so commonly found on animals are parasites which pass their entire existence upon their host and are transmitted from one animal to another by direct transfer. They deposit eggs, which are attached to the hairs or feathers of their host and the young lice grow directly to maturity after hatching.

Many species of ticks are known which occur on domestic animals and some of them are of particular importance and interest as transmitters of protozoan parasites. The most important tick of this country is the Texas fever cattle tick. The females fall from their host when ready to deposit their eggs, which are laid in a mass of several hundred and hatch after a period of incubation varying somewhat according to the temperature. The small seed ticks or larvæ which possess only three pairs of legs, are able to live without food for a considerable length of

time, but finally die unless they find a host. If a suitable host animal is found they attach themselves by means of their proboscis, grow for about a week and then cast their skins, emerging with eight legs. This second stage lasts about another week, during which considerable growth occurs, and then the molting process is repeated, giving rise to the matured male or female tick, also with eight legs. At this time the female is little larger than the male, but she soon begins to swell out and about three weeks later is fully engorged and ready to fall to the ground and lay her eggs.

Normally Texas fever ticks remain upon the same host until they have grown to complete maturity, but recent experiments have proved that these ticks taken from an animal at the time of either molt will continue to develop if placed on other cattle. It has been found that Texas fever ticks will sometimes develop to the adult stage upon cats and dogs, but as a rule this species is restricted to cattle and other large animals, such as deer, horses, mules, and donkeys.

Other species of ticks have a life history somewhat different from that of the Texas fever tick and fall from their host each time when ready to molt, crawling back upon the same or a different host after molting. Some ticks pass their larval stage upon rabbits and other small rodents, reptiles, and birds, and do not attach themselves to dogs and cattle until they have attained the adult age. The well-known little red mite is one of the most persistent and injurious of the parasites affecting chickens. Although apparently depending entirely upon blood for food it is not permanently parasitic, attaching itself to the bird only at night. As it is a very fertile breeder and can live away from the host for months, it is a very difficult parasite to destroy. The eggs are deposited in corners, cracks, and other such places in which the mites hide during the day.

The various species of scab mites are permanent parasites and undergo all their life cycle on the bodies of their hosts. Eggs are deposited amid the scabs or in the burrows produced by the mites, and from these are hatched the larvæ, which in due course develop into nymphs and finally into adults. Transmission of these forms as a rule depends upon contact of the diseased animals with other animals and the consequent transfer of mites or their eggs. Tags of wool on fences are a frequent means of transmission in the case of sheep scab.

The tongueworm, so called for its shape, occurs when adult as a parasite in the nasal cavity of various animals, one of the most common hosts being the dog. In its larval stage it is found in the viscera of various animals, especially in the mesenteric glands and the liver. Its transmission from dogs to cattle, sheep, etc., and vice versa, is as follows:

The eggs produced by the adult are discharged from the dog's nose by sneezing and thus scattered in various places, from some of which (grass, lettuce, etc.) they are liable to be picked up and eaten by various animals.

After having been freed by the action of the digestive juices on the shells of the eggs they migrate to the liver or mesenteric glands where they undergo considerable development. If organs thus affected are now eaten by a dog the young tongueworms gain access to the nasal cavity and develop to the adult stage. This parasite is one of several, more or less dangerous, for whose dissemination the dog is responsible, and on account of which dogs, even though apparently healthy themselves, are often the source of great danger to the health of men and live stock.

Most of the roundworms living in the digestive organs are transmitted from one animal to another by eggs or embryos which, while they may have to undergo a certain amount of development in the outer world, do not require an intermediate host. In such cases animals become infected by swallowing the eggs or embryos in the water or food which has been soiled directly or indirectly with the manure of animals infested with the matured egg-producing worm. Although it is not known certainly, such seems to be the manner in which the stomach worm or twisted wireworm of sheep is transmitted. The eggs are scattered by infested sheep over the pastures and in a few hours or days they hatch. The embryos are able to live for a considerable time in water or damp earth—just how long is not known, but do not complete their development until picked up again by sheep or cattle, which may happen while these animals are grazing or drinking. It is evident that the draining of damp pastures and the protection of the water supply from contamination with manure are important points in the prevention of infection with this parasite.

In some species of roundworms the eggs are thick-shelled and do not hatch until they are swallowed by the proper host. Such eggs are usually very resistant and will pass through many unfavorable conditions which would prove speedily fatal to thin-shelled eggs and free-living embryos. The whipworms found in the large intestines of man are all forms with thick-shelled eggs. Such parasites are transmitted by the food or water or accidentally by other articles soiled with the eggs.

It has recently been discovered that some species of roundworms which are parasitic in the intestines are not only transmitted by the swallowing of their embryos but also by the penetration of these embryos through the skin. The hookworms, of which a number of species infesting different animals are known, are thus transmitted. The eggs, which are thin shelled, hatch in a few hours after leaving the intestine and the embryos become free in the water or damp earth. After undergoing a certain amount of growth they are ready to develop to maturity if swallowed, or if they are brought into contact with the skin, as may readily happen by the soiling of the body with infested dirt, they will wriggle their way into the hair follicles and continue to work through the tissues until they come to a blood vessel. They are carried by the circulation to the heart and then to the lungs. In the lungs they leave

the blood vessels and enter the air cells and moving outward along the air passages they finally leave the windpipe, enter the esophagus, then the stomach, and at last in this round-about way reach the intestine.

The life histories of the roundworms found in the lungs of cattle, sheep and swine are not known, but there are indications that some of these forms pass a portion of their embryonic development in earthworms. The embryos of the worm whose presence in the windpipe causes "gapes" in chickens also seem sometimes to enter the bodies of earthworms, but these worms are not necessary intermediate hosts and the parasite may be transmitted directly by swallowing the embryos either before or after they are hatched from the eggs. The eggs or embryos of lungworms reach the outer world in the sputum coughed up from the lungs of their hosts.

Although direct development is the rule among roundworms, there are many species which must necessarily pass through an intermediate host before they can develop to maturity. *Trichinella spiralis* is such a form and well known on account of the serious disease known as trichinosis which it produces in man. This parasite exists in all animals, the most common hosts, however, being pigs, rats, and human beings. The adult forms which occur in the intestines are short-lived, but each female during her life of a month or less produces from 10,000 to 15,000 embryos which are already hatched when born. The embryos penetrate the wall of the intestine and work their way through the tissues and are able to reach nearly every part of the body in large numbers by means of the circulation. They finally settle down in the muscles and become encysted. During the period of this migration very serious symptoms are produced in man and in case of heavy infestation death commonly results. Pigs, however, stand even very heavy infestation fairly well and rarely die. The embryos will remain alive encysted in the muscles until the flesh containing them is eaten by some animal. If swallowed the embryos are set free and within a week have grown to maturity and are producing embryos in their turn. From the foregoing it is evident that man acquires the parasite by eating pork infested with the encysted embryos. Such pork, however, is only dangerous when raw or imperfectly cooked. Thorough cooking kills the embryos and renders the most heavily infested meat harmless. Pigs acquire this parasite in two ways—by devouring the carcasses of infested pigs or by eating infested rats. The feeding of hogs with offal at slaughterhouses is a common way in which the parasite is spread and rats about slaughterhouses become infested in a similar way.

Tapeworms of every species whose life history is known, with few exceptions pass a portion of their existence encysted in the tissues of some animal before attaining maturity in the final host. The encysted, or bladder-worm stage commonly occurs in animals which serve the final hosts for food. Thus one of the tapeworms of man passes its intermediate stage in cattle, another in hogs. The cat has a tapeworm

whose intermediate stage is found in rats and mice. Two of the tapeworms of dogs pass their bladder-worm stage in rabbits, and many of the tapeworms of birds occur in insects during their intermediate stage. In each case the intermediate host becomes infected by swallowing the eggs from the mature tapeworms which are scattered about in the droppings of the final host, and the final host becomes infected by swallowing the bladder-worm which is encysted in the tissues of the intermediate host. Three of the tapeworms of dogs are of particular interest because their intermediate stages occur in live stock. The intermediate stage of one occurs also in man.

The adult *Echinococcus* tapeworm, a tiny creature a fraction of an inch long, is comparatively harmless to the dog which it infests, but in its intermediate stage is one of the most fatal parasites known, especially to man. It is transmitted to man, cattle, sheep, and other animals by the eggs of the tapeworm, which may be conveyed by various articles contaminated by infested dogs, such as grass, water, raw vegetables, etc., while the dogs become infested by eating the carcassess of animals infested with the bladder-worm stage. House dogs infested with this parasite are a source of great danger to human beings. In petting them the hands are very liable to pick up some of the eggs with which the hair of the dog may be soiled, or the dog in licking himself may get some of the eggs upon his lips and tongue and later transfer them to some one's hand or face, from which they may readily get into the mouth. An egg of this tapeworm having been swallowed hatches out in the stomach or intestines. The embryo then works its way out of the alimentary canal by means of six tiny hooks with which it is supplied and after more or less wandering finally settles in the liver, kidneys, lungs, or almost any organ of the body.

The most important measures of prevention are:

(1) The destruction of stray and superfluous dogs. (2) The proper disposal of the viscera of slaughtered animals so that infested organs can not infect dogs. (3) The chances of infestation in the case of man may be greatly reduced by handling dogs as little as possible and by banishing them from dwelling houses.

The intermediate stages of the gid tapeworms and the marginate tapeworm of dogs occur in live stock, but are not transmissible to man. The mode of transmission is essentially the same as that of the *Echinococcus* parasite.

The thin-necked bladder-worm which is the intermediate stage of the marginate tapeworm is very common in this country, but seems to do little damage, except in cases of heavy infestation in young stock.

The gid bladder-worm, on the other hand, is a very dangerous parasite. It develops in the brain or spinal canal, sometimes attaining the size of a hen's egg. Sheep are more commonly attacked, though cattle and other animals are not exempt. The disease produced is commonly

known as "gid" on account of the behavior of the infested animals, giddiness or turning a circle being a frequent symptom, resulting from the pressure of the bladder-worm on the brain. Nearly 100 per cent of the animals infested ultimately die and flocks of sheep are sometimes almost entirely annihilated. Some tapeworms are transmitted by the external parasites of their hosts, as for example the double-pore tapeworm of the dog, which passes its intermediate stage in fleas and lice.

The skin, hair, and bedding are of course more or less soiled with the eggs of the tapeworm. Fleas and lice are consequently liable to become infested while feeding, while the dog in turn acquires the parasite from swallowing infested lice or fleas.

The history of the parasite which causes malaria in man, for example, is now very well known. Certain kinds of mosquitoes while sucking blood from malarial patients take up at the same time some of the malarial parasites. If these parasites are at the proper stage they undergo certain changes and bore into the wall of the stomach of the mosquito, where they become encysted. Within these cysts are formed a large number of slender bodies known as sporozoites which, after the bursting of the cysts, migrate to the salivary glands of the mosquito. These sporozoites are the infecting stage of the parasite, and when the mosquito bites again they are injected with the saliva into the blood, and a new case of malaria is begun. Birds are subject to parasites resembling the malarial parasite of man and likewise transmitted by mosquitoes.

Blood-sucking flies, as well as mosquitoes and ticks, also play a part in transmitting protozoan diseases.

The parasites known as *Trypanosomes* are in some cases transmissible by flies and mosquitoes. The fatal effects of the bite of the tsetse fly from which formerly so many cattle and horses died in Africa, are not due to any poison secreted by the fly, but to a disease caused by a species of trypanosome, which is injected into the blood at the time of the bite and multiplies there. In a similar way fleas and sucking lice also seem sometimes to transmit trypanosomes.

ULCERATIVE LYMPHANGITIS.

By Dr. J. A. THOMPSON.

Ulcerative lymphangitis exists in Japan, China, India, Africa, England, and in all parts of the Philippine Islands. It is an infectious disease and appears in the form of a suppuration of the lymphatic glands. Usually the superficial glands only are involved, but sometimes the internal ones are also affected, though such a condition is rare. The animals usually attacked are horses, but cases have been known among cattle.

The disease has long been recognized, but formerly was confounded with the farcy form of glanders and was regarded by most authorities as a mild and curable form of that disease. But in 1873 the specific organism,

which is called the Saccharomycosis farcimininosis, was discovered by Rivolta. The organism is round and is from three to four microns in diameter. It is easily recognized under the microscope by its clear double outline. The organism is found in the diseased tissue and adjacent lymph vessels and also in the discharge, both free and inclosed in pus cells.

The disease can be introduced only by the transfer of a portion of the discharge from the ulcers of one animal to a cut or some raw surface on the body of another. This can be done in many ways—possibly flies are the most frequent cause of infection. By lighting on the ulcers of a diseased animal they can take up the organism and carry it to a cut or raw surface upon another. Horses may also become infected by rolling in the dust where infected animals have been or by rubbing on infected posts. A careless attendant could easily carry the disease from one horse to another with his hands or by using an infected curry comb and brush. It might also be acquired by eating infected feed if there were any ulcerations in the mouth, stomach, or intestines. If infection took place in this manner it would probably be manifested by a suppuration of the internal lymph glands. The period of incubation is from two weeks to two months and might be even longer.

The first symptom noticed is the swelling of some group of lymph glands. These swellings appear in the form of a chain and vary in size from that of a hen's egg to that of a pea. The nodules are hard, well defined, and painful. The largest ones are usually in the middle of the chain and they gradually diminish in size toward the ends. The glands usually affected are the prepectoral, but those of the fore leg above the knee and of the hind leg above the hock are very frequently the seat of infection, as are also those of the sides and back. Sometimes, but rarely, the glands of the lungs, liver, mesentery, and other internal organs are affected. Usually only one or two groups are involved at the same time, but some times the horse is literally covered with nodules and ulcers.

The swellings, or nodules, suppurate and break, forming ulcers and discharging a thick yellow pus which is mixed with blood and which afterward becomes oily and glossy. These ulcers have a hard base and well-defined edges. The center is bright red and is covered with exuberant granulations. The course of the disease is usually from two months to one year and it is difficult to cure quickly on account of the fact that new ulcers are continually forming to take the place of the ones that heal.

The appetite is not usually affected and continues good throughout the entire course, but in a long-continued case the animal often becomes very much emaciated. There is usually a rise in temperature but it seldom goes over 102° F. and is higher at the start than at any other time except in those cases which terminate unfavorably.

This disease might be very easily mistaken for glanders and especially so when ulcers are formed in the nostrils. It can be differentiated from

glanders by the discharge, which in that disease is amber-colored, has an offensive smell, and is very sticky, and also by the number of ulcers being usually much greater in lymphangitis than in farcy. The submaxilliary lymph glands are seldom swelled in lymphangitis. The surest method is to use the mallein test or to make a microscopic examination of the organism.

Lymphangitis is rarely fatal when treatment is properly applied, and even without treatment there is an excellent chance for recovery. The chief damage lies in rendering the animal unfit for work and the emaciation produced. The treatment is both external and internal. There are many methods employed in the external treatment and they are all more or less successful. The usual method is to cauterize the ulcers with some agent such as pure carbolic acid, silver nitrate, or a strong solution of bichloride of mercury. This is followed by drying powders, such as calomel, air-slaked lime, or aristol. Iodoform is an excellent agent but can not be used very long or over a very great surface as iodoform poisoning is very likely to result. Good results have been obtained by packing the abscess with arsenious acid and also with cotton soaked in a 10 per cent solution of potassium iodide. The nodules which have not yet suppurated can be treated with a cantharides blister or painted with iodine. The internal treament is at first to give the animal a good purgative and follow it with a tonic. The tonic should be accompanied by half-ounce doses of potassium iodide twice a day, but this should not be continued very long without intermissions.

THE SUBPROVINCE OF BUKIDNON.

By Lewis S. Thomas.

The subprovince of Bukidnon, which was formed in August, 1907, is part of the Province of Agusan, Island of Mindanao. Its eastern boundary is the western edge of the watershed of the Agusan River. From this watershed it extends along the northern edge of the plateau of central Mindanao to the eastern boundary line of the district of Lanao, Moro Province. The southern boundary is the eighth parallel of north latitude. A large, indefinite section back of Langaran and Oroquieta also belongs to the subprovince. Under the law organizing it all the territory inhabited by non-Christian tribes formerly in the Province of Misamis was included therein. Bukidnon is in charge of a lieutenant-governor under the provincial board of Agusan.

The subprovince may be divided into four sections. The first extends from the Agusan watershed westward to the Tagoloan River. This section is rough, mountainous, and very heavily wooded. It includes the headwaters of the Pulangui and Tagoloan Rivers.

The second section reaches from the Tagoloan to the Cagayan River, forming the pass from the seacoast to the central plain of Mindanao. It includes the wide valley of the upper Pulangui River; a long stretch of almost level land extending to the seacoast, and a grassy plain along the northern slope of Mount Quitanlad to the valley of the Cagayan River. Mount Quitanlad and several hills break it into smaller sections and three large canyons cross it at intervals of about 20 miles.

The valley of the Cagayan River forms the third section. This is rather rough, being cut up into small plateaus until it merges into the mountains from which the Cagayan River flows.

Back of Langaran and Oroquieta is the fourth section, the geography of which is but little known.

In the first section there are many settlements of more or less civilized people who grow abacá, coffee, cacao, and a very acceptable grade of tobacco. Besides these, there is a large population of entirely savage people who grow the same products as their more civilized neighbors and also secure a quantity of forest products for trade. Still the contour of the section and the lack of means of access render it of little value to the man who wishes to engage in planting at the present time.

The second section holds out the best promise to the prospective planter. From a line drawn some 10 miles inland all the way to the Pulangui there is land that is really tempting. The planter needs horses or carabaos, disk and share plows, cultivators, harrows, mowing machines, and hydraulic rams. The woodland lies so far back from the trail and is so difficult of access that no one but the natives would think of making clearings and even they are gradually returning to the cultivation of the grass lands in the vicinity of the towns.

From Tangculan to the Cagayan Valley there are splendid stretches of agricultural land between Quitanlad and the sea. This is perhaps best adapted to coffee and cacao, especially close to the mountain slope. There is not much cogon grass, the growth being mainly sigpang, a fern-like plant. Its presence always denotes a cold, moist locality and the soil never becomes so hard and dry as does cogon land in long continued droughts.

The land around the base of Quitanlad to Sumilao is of the same character. Sumilao is the principal coffee-producing section in the market sphere of Cagayan. The three canyons mentioned lie between here and a few miles south of Impasugong. In the vicinity of Impasugong there is a plain where a corporation could find available all the land the law allows it.

From the canyon of the Atugan, near Impasugong, southward to the capital, Malaybalay, there are large, well-watered plains with small gulches between.

Eight miles south of Malaybalay the plateau falls into the great plain of the Pulangui. As mere scenery this presents a panorama of beauty and grandeur probably unsurpassed in the Philippines. The level land begins at Linabo and extends along both sides of the Pulangui as far as one can see. Here are plains of short, thick cogon interspersed with patches of timber along the numerous streams that water the land. These plains extend to the Muleta River, the head of navigation on the Pulangui from Cotabato.

One piece of level land including about 20 square miles is surrounded on three sides by the Malaybalay River. Where the Malaybalay issues from the uplands there is a good place to tap its flow and irrigate the whole surface. Here is situated the hacienda of Barton, Thomas & Co. Good crops of rice and corn have been harvested on their lands this year, the yield being estimated at 35 cavans per acre.

On the other side of the Pulangui River is another plain adapted to growing almost any crop, upon which Lieutenant-governor Lewis has recommended the placing of motor-pulled gang plows to prepare the land for settlements of wild people.

There is also much tillable soil in the third section, the Cagayan Valley. Agricultural machinery can be used to advantage in many

places, but the plain above the river bed is more broken than is the second section. Good bottomland is also available.

As for the fourth section, that lying back of Langaran and Oroquieta, there is so little definite knowledge of the character of the country that not much can be said in regard to it. It produces a considerable amount of hemp but is not developed at all.

As in all other parts of Mindanao where there are extensive plantations, the labor problem is a perplexing one. There is not a very large native population and the people have their own small plantings to take care of. In the Pulangui Valley an uncertain labor supply is afforded by the savages living up the river. But they are difficult of access and are apt to have their own work to do just when the planter needs them the most. Besides, their manner of living makes it impossible to obtain them in any numbers. They have not the strong tribal or patriarchal organization that is common among the other non-Christian tribes of Mindanao. However the adaptability of the country to the use of machinery reduces the necessity for a large force of laborers.

Transportation will be the most difficult question for the prospective planter to solve, as the good land lies at least a day's ride from the seacoast, and at present packing is the only method used. But all the part of the trail connecting the Pulangui Valley with the seacoast has been greatly improved since the establishment of the subprovince. The road from the seacoast up to the plateau lies in the Province of Misamis but it is very probable that the authorities of that province would do their share in making it a good road. From Tangculan inland there have been erected sixteen good durable bridges, the longest being 178 feet in length. The work already done on the trail is enough to give promise of a wagon road in two years. The trails in the three great canyons have been changed from narrow crooked tracks to wide roads winding up in long reaches. In other places the trail has been changed to go around hills instead of passing over them.

A great variety of products is grown in the subprovince, hemp being the principal crop. This is, however, a result of the artificial stimulation produced by the high prices of the last few years. From the first section, in the vicinity of Malitbog and generally in the deep gulches, there comes a very fine soft grade of fiber. The second section also produces a fiber that brings a price slightly higher than the general run of hemp in the Cagayan market. But the great hemp belt is from Linabo down toward the Muleta River. Hemp here is seen 35 high and the fiber often is 10 to 12 feet in length. Of course the natives know nothing of cultivating the plains, largely on account of the lack of available animals. But on the Barton, Thomas & Co. plantation can be seen a very fine lot of hemp grown in plowed cogon land.

Until the price dropped in the Singapore market there was a good

deal of trading done in gutta-percha. While no experiments have been made in rubber growing, there is so much wild rubber to be seen that it is easy to believe the cultivation could be made successful. Rubber vines have also been found in the vicinity of Alanib, which is on the Pulangui watershed.

Malitbog, in the first section, produces a grade of tobacco very highly regarded in the local markets. This is grown mainly on clearings. But at several places, including Impasugong, in the second section, tobacco has been grown on land cultivated with a plow. Good specimens of the plant have also been seen in Malaybalay and at various places in the Pulangui valley.

Coffee and cacao grow everywhere and are the principal crops on the slope of Quitanlad and in the region about Tangculan. Sumilao, in particular, also pays more attention to coffee than to any other crop. In the Sumilao district trees have been seen giving fruit a year after transplanting. In this crop also the native does not attempt any careful cultivation. The trees are planted so closely together that no weeds can live, but the coffee trees themselves waste a large part of their strength in seeking the light. Malaybalay also produces coffee, and cacao seems to flourish on the high land. The Cagayan Valley produces a good grade of coffee. In this section there is one American planter, Mr. Weaver, engaged solely in the planting of these two crops.

American cotton seed has been tried, producing a good-sized boll with plenty of lint. Unfortunately, the plants matured before the rainy season was over and many of the bolls rotted.

There is another kind of cotton grown here which has aroused interest in Manila. This is the bush cotton, or Gapas sangley, or moro, as it is variously called. The bush produces plentifully, the seeds are easily extracted, and the lint comes out freely. The fiber is rather short, curly, and coarse, and cloth made from it is very durable.

Kapok, or tree cotton grows everywhere but no attempt is made to use the fiber for commercial purposes.

Isolated specimens of citrus fruit produce so well that there is some promise of profit in their cultivation. The Jesuit Fathers at Sumilao seldom lack oranges and lemons. Every town is shaded with large grapefruit trees. The fruit is, however, not of the best character. The schoolboys use the smaller fruit, while unripe, as a substitute for baseballs. There are now weekly steamers from Cagayan to Cebu and biweekly steamers from Cagayan to Manila. This should make it possible for a planter no more than a day from Cagayan to get the product to market before spoiling.

Last of all, there are great opportunities for the raising of rice and corn. With a wagon road, which seems very probable now, these could well be sold in the Cagayan market in competition with the imported rice.

Besides, there is a large local demand in trade for hemp and the other products. Lieutenant-Governor Lewis is striving to obtain an increased amount of these cereals for, unfortunately, the people do not at present raise enough for their needs. However, the harvest this season is very much larger than last year's owing to the governor's continual urging of the people to plant near the towns. For the raising of rice and corn there is no better region than the Pulangui Valley, not only in this subprovince but in all Mindanao as well.

Other cereals that grow well are sesamum, small millet, and "aglay," used principally in the manufacture of "pangassi," the local entertainment drink.

At no place is the subprovince less than 1,000 feet above the level of the sea. The climate is fairly equable with days tempered somewhat by the continuous breezes and nights at times really cold. No data as to the rainfall have ever been gathered, but since 1905 there have been no continued dry spells, and there is generally rain every month. As a rule whatever dry spell there is begins in January and ends with the heavy rains in April.

CURRENT NOTES.

Philippine Carnival, Manila, February 2 to 16, 1909.—The total sum of prizes offered by the Philippine Carnival Association amounts to ₱12,000. These prizes are divided as follows:

Best complete industrial display.—First prize, ₱5,000; second prize, ₱1,000.

Prizes for excellence along individual lines, as follows:

Woodwork, carving and furniture.—First prize, ₱700; second prize, ₱200.

Fibers and fabrics.—First prize, ₱500; second prize, ₱125.

Needle and fancy work.—First prize, ₱500; second prize, ₱100.

Pottery.—First prize, ₱400; second prize, ₱75.

Metal work.—First prize, ₱400; second prize, ₱75.

Art goods.—First prize, ₱500; second prize, ₱100.

Curios.—First prize, ₱400; second prize, ₱75.

Marine products.—First prize, ₱400; second prize, ₱75.

Agricultural products.—First prize, ₱700; second prize, ₱200.

Foods.—First prize, ₱400; second prize, ₱75.

The provinces and municipalities are urged to take part in these competitions. Full particulars regarding the conditions under which the competition is to take place can be had by addressing a letter to Mr. G. A. O'Reilly, director-general, Philippine Carnival Association, Manila.

Hemp Dealers' Association.—A hemp dealers association has been formed in Manila. The organization is made up principally of Manila dealers or brokers, but hemp planters can join it according to the provision of paragraph (*c*), section 4, of the by-laws. A number of planters from the Provinces of La Laguna, Tayabas, Capiz, and Leyte have already joined the association.

Its main object is to improve the market for Manila hemp, which is the most important export product of the Archipelago. There was a reaction in the market shortly after the formation of this society, prices having increased about 10 per cent. The board of directors is composed of Messrs. Luis Hidalgo, Enrique Gil, and Benito Sy Conbieng.

Grass for gardens and parks.—It has been found after many experiments in Manila, that Bermuda (*Cynodon dactylon*) is the best grass for lawn making in these Islands. It is known as *grama* in Spanish, *kawadkawaran* or *malit* in Tagalog and *palagtiki* in Visayan. It is the

one planted and cultivated in the Botanical Garden and other parks in Manila, and is found growing abundantly along roads, in open fields, and cultivated lands. In many places in the Islands it makes good pastures and produces a valuable green fodder, which is generally gathered by children and sold at a good price.

In order to make a lawn the land should first be plowed or broken with a hoe and then harrowed to a fine condition and leveled. The stems should be pulled out and cut into sections about 10 centimeters long and planted in rows about 30 centimeters apart. If planted in the dry season it is better to sprinkle early in the morning and late in the afternoon during a period of two weeks, which is generally sufficient for the grass to take root. When sufficiently developed it should be clipped close every month with a mowing machine to make a fine sod.

Paper made from rice straw.—Mr. W. D. Wing, of Bangor, Maine, has been successful in using rice straw for paper making. He will erect pulp mills in the rice section of the South, to make pulp of the rice straw which will be sent to the paper factories in the North.

According to Mr. Wing the rice growers will be able to get ₱4 out of each ton of straw; as a hectare yields five tons planters will get ₱20 from each hectare of land, which will be sufficient to defray the expenses incurred by irrigation.

Rubber plantation.—The Compañia General de Tabacos de Filipinas, which owns large tracts of land in the Province of Tarlac, is contemplating the planting of Mexican (*Castilloa elástica*) or Brazilian (*Hevea braziliensis*) rubber in a section mostly covered by forest. This work is under the direction of Mr. Vicente W. Pastor, agricultural engineer.

Silk.—As previously noted in our REVIEW the Bureau of Agriculture has been conducting a series of experiments in silk culture in coöperation with the Bureau of Science. The silk from the cocoons raised in these experiments has been woven into cloth, and may be seen at the office of the Bureau.

It is designed to continue the work by interesting the people in the provinces, through the coöperation of the Bureau of Education, by sending a representative to those schools which seem to be interested in this work and show them how to start the work.

The first essential in starting the work is a good supply of white mulberry trees. These should be started from cuttings and be at least eight months old before enough leaves can be gathered to feed any quantity of silkworms.

The Bureau expects to have a supply of worms on hand so that those desiring eggs may be supplied as soon as mulberry trees can be grown.

Seed distribution.—The annual seed distribution of the Bureau will begin about December 15th. Only small quantities of these seeds will be sent to one person, and only such seeds are distributed as are suited to

climatic conditions here. Few, if any, native seeds are distributed. It is suggested that school children desiring seeds make request through the teacher.

Horse breeding.—Col. John Van R. Hoff, chief medical officer, Division of the Philippines, donated to the Bureau of Agriculture, on his departure for the United States a few weeks ago, an elegant pair of standard bred mares, to be used for breeding purposes. They form one of the most valuable additions which has been received since the shipment of thoroughbreds which came out on the transport *Dix* in 1904. They are large, well-formed animals, iron gray in color, thoroughly broken as a carriage pair for city use, and are valued at about ₱2,000.

Horse breeding has recently received quite an impetus by the transfer from the United States Army in the Philippines to the Bureau of Agriculture of 79 head of breeding stock. Of these, 2 are stallions, 39 mares, and 38 colts. Of the latter more than half are a year and over in age and there are about half a dozen young stallions which will be ready for service within one year.

For the present these horses have been sent to the Alabang Stock Farm where they are being cared for as well as possible. It will, however, be necessary to build additional barns there, as the Bureau has more than 100 horses and only about sixty stalls.

The mature animals will be used for light work on the farm just as is done on breeding farms in the United States.

Particular attention will be paid to breeding cavalry horses and mules for the Army.

CROPS PLANTED AND HARVESTED AND CONDITION OF SAME TAKEN FROM MONTHLY CROP REPORTS FOR THE MONTH OF OCTOBER, 1908.

[RICE.—Attention is invited to the fact that this article should be understood as being in the unhulled state.]

Province and crops.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Agusan (reports from 2 towns):	*Hectares.*		*Hectares.*		
Rice	14	Good			
Abaca		do	14	200	Piculs.
Coconuts		do		20,000	Nuts.
Corn		do			
Albay (reports from 12 towns):					
Rice	1,430	do	1,393	29,417	Cavans.
Abaca	319	do	6,380	20,808	Piculs.
Coconuts		do		573,500	Nuts.
Corn	3	do	26	282	Cavans.
Ambos Camarines (reports from 29 towns):					
Rice	12,685	do	1,378	19,965	Do.
Abaca	115	do	2,542	5,559	Piculs.
Coconuts		do		2,126,700	Nuts.
Corn	2	Fair	469	541	Cavans.
Antique (reports from 8 towns):					
Rice		Good	3,508	43,550	Do.
Abaca	7	do	11	30	Piculs.
Coconuts		do		1,500	Nuts.
Sugar cane		do			
Bataan (reports from 5 towns):					
Rice		do	325	10,100	Cavans.
Coconuts		Fair			
Sugar cane		do			
Corn		do	200	1,000	Do.
Batangas (reports from 13 towns):					
Rice	50	do	16,803	119,114	Do.
Abaca		do	18	60	Piculs.
Sugar cane		Good			
Corn	709	do	110	70	Cavans.
Benguet (reports from 12 towns):					
Rice		Fair	56	274	Do.
Sugar cane		do			
Coffee	4	do			
Corn	6	do			
Bohol (reports from 25 towns):					
Rice	422	Good	2,121	31,267	Do.
Abaca	21	do	113	260	Piculs.
Coconuts		do		2,937,650	Nuts.
Corn	867	Fair	26	72	Cavans.
Bulacan (reports from 10 towns):					
Rice		do	180	5,000	Do.
Coconuts		do			
Sugar cane		Good	4		
Corn		Poor			
Cagayan (reports from 11 towns):					
Rice	1,403	Fair	1,976	14,416	Do.
Coconuts		Excellent		13,300	Nuts.
Sugar cane	5	Good	98	140	Piculs.
Corn	10	Fair	320	9,600	Cavans.
Capiz (reports from 19 towns):					
Rice	128	do	11,946	293,027	Do.
Abaca	27	do	105	1,269	Piculs.
Coconuts		do		347,000	Nuts.
Corn	30	do	25	85	Cavans.

Crops planted and harvested and condition of same taken from monthly crop reports for the month of October 1908—Continued.

Province and crops.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Cavite (reports from 10 towns):	*Hectares.*		*Hectares.*		
Rice	140	Good	330	5,570	Cavan.
Corn	44	do			
Abaca		do	4	8	Piculs.
Coconuts		do		3,000	Nuts.
Cebu (reports from 30 towns):					
Rice	446	Fair	5,409	8,918	Cavans.
Maguey	111	Good	88	191	Piculs.
Coconuts		do		426,500	Nuts.
Corn	26,487	Fair	51,188	72,315	Cavans.
Ilocos Norte (reports from 9 towns):					
Rice		Good	571	2,523	Do.
Maguey	5	do			
Sugar cane		Fair	200		
Corn	18	Good	10	10	Do.
Ilocos Sur (reports from 21 towns):					
Rice	1,080	Fair	259	744	Do.
Sugar cane		do	8		
Corn	5	Good			
Maguey	15	Fair			
Iloilo (reports from 14 towns):					
Rice	7,485	Good	7,320	69,000	Do.
Abaca	460	do	260	624	Piculs.
Maguey	1,000	do			
Coconuts		do		43,050	Nuts.
Isabela (reports from 3 towns):					
Rice	1,000	Fair	1,000		
Sugar cane	3	do			
Corn		do			
La Laguna (reports from 17 towns):					
Rice	1,483	Good	982	11,781	Cavans.
Coconuts		do		4,218,800	Nuts.
Sugar cane	27	do	16	75	Piculs.
Corn	190	do	112		
La Union (reports from 11 towns):					
Rice		Fair	1,257	10,696	Cavans.
Coconuts		Good		43,000	Nuts.
Sugar cane		do			
Corn	6	Excellent		5	Cavans.
Lepanto-Bontoc (reports from 13 towns):					
Rice		Good	164	995	Do.
Coconuts		do		2,050	Nuts.
Maguey		do			
Sugar cane		Fair			
Leyte (reports from 18 towns):					
Rice	148	Good	922	6,968	Cavans.
Abaca	99	do	11,600	45,782	Piculs.
Coconuts		do		1,190,678	Nuts.
Corn	398	Fair	197	2,747	Cavans.
Mindoro (report from 1 town):					
Rice		Poor	110	2,050	Do.
Abaca			60	60	Piculs.
Coconuts				15,000	Nuts.
Misamis (reports from 5 towns):					
Rice	70	Good	92	2,880	Cavans.
Abaca	10	do	31	418	Piculs.
Coconuts		do		151,200	Nuts.
Corn	53	Fair	8	675	Cavans.
Moro (reports from 6 towns):					
Abaca	5	Good	58	3,642	Piculs.
Coconuts		do		167,025	Nuts.
Corn	8	do	175	750	Cavans.
Rice		do	270	6,350	Do.
Nueva Ecija (reports from 16 towns):					
Rice	1,540	do	168	3,526	Do.
Coconuts		do		10,250	Nuts.
Sugar cane	18	do	20		
Corn		do	50	700	Cavans.
Nueva Vizcaya (reports from 4 towns):					
Rice	465	do	365		
Coconuts		do			
Sugar cane		do			
Corn		do			

Crops planted and harvested and condition of same taken from monthly crop reports for the month of October 1908—Continued.

Province and crops.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Occidental Negros (reports from 13 towns):	*Hectares.*		*Hectares.*		
Rice	300	Fair	10,805	20,370	Cavans.
Coconuts		Good		69,000	Nuts.
Sugar cane	855	Excellent	1,280	13,600	Piculs.
Corn	2,011	Fair	4,140	5,800	Cavans.
Oriental Negros (reports from 10 towns):					
Rice	50	do	256	4,879	Do.
Coconuts		do		1,166,000	Nuts.
Sugar cane	1	do	284	1,154	Piculs.
Corn	2,080	do	1,910	15,625	Cavans.
Palawan (reports from 3 towns):					
Rice		do	700	20,000	Do.
Abaca		do			
Coconuts		do			
Sugar cane		do			
Pampanga (reports from 13 towns):					
Rice	165	Good	100	150	Do.
Sugar cane		do			
Cacao		do			
Corn				202	Do.
Pangasinan (reports from 31 towns):					
Rice	3,683	do	6,704	13,805	Do.
Coconuts		do		121,438	Nuts.
Sugar cane	29	do	5	50	Piculs.
Corn	52	do	22	492	Cavans.
Rizal (reports from 14 towns):					
Rice	3	do	268	1,049	Do.
Coconuts		do			
Corn	14	do	4	63	Do.
Sugar cane	2	do			
Samar (reports from 17 towns):					
Rice	84	do	160	845	Do.
Abaca	27	Fair	5,515	5,001	Piculs.
Coconuts		do		1,692,800	Nuts.
Corn	6	do	72	372	Cavans.
Sorsogon (reports from 13 towns):					
Abaca	73	Good	5,017	9,556	Piculs.
Coconuts		do		224,667	Nuts.
Sugar cane	10	do	80	2,810	Piculs.
Rice	10	do	29	340	Cavans.
Surigao (reports from 4 towns):					
Abaca	43	Fair	306	1,741	Piculs.
Coconuts		Good		22,000	Nuts.
Sugar cane	6	Excellent	16	9	Piculs.
Corn		do	200	10,000	Cavans.
Tarlac (reports from 9 towns):					
Rice	1,700	Good	2,467	40,256	Do.
Sugar cane		do			
Corn	31	do			
Maguey		do			
Tayabas (reports from 14 towns):					
Rice	3,083	do	3,852	31,631	Do.
Abaca	3,429	do	288	707	Piculs.
Coconuts		do		1,132,500	Nuts.
Sugar cane	5	do	8	5	Piculs.
Zambales (reports from 7 towns):					
Rice	6,225	do	66	330	Cavans.
Coconuts		do		5,400	Nuts.
Sugar cane		do	5		
Corn		do			

RANGE OF PRICES OF PHILIPPINE AGRICULTURAL PRODUCTS.

Highest, lowest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the month of October, 1908.

Province.	Rice, unhulled, per cavan.			Abacá, per picul.			Copra, per picul.		
	High-est.	Lowest.	Aver-age.	High-est.	Lowest.	Aver-age.	High-est.	Lowest.	Aver-age.
Agusan	₱2.00	₱1.00	₱1.50	₱8.00	₱7.00	₱7.50	₱6.00	₱6.00	₱6.00
Albay	3.62	2.50	3.06	9.50	6.50	8.00	6.00	5.25	5.62
Ambos Camarines	5.00	1.50	3.25	15.50	4.00	9.75	6.60	4.00	5.30
Antique	2.25	1.25	1.75	22.00	6.00	14.00	6.50	6.00	6.25
Bataan	3.00	1.80	2.40						
Batangas	4.00	2.20	3.10	16.00	12.00	14.00			
Benguet	5.00	3.00	4.00						
Bohol	3.50	2.00	2.75	15.00	5.00	10.00	7.80	6.00	6.90
Bulacan	3.00	2.00	2.50						
Cagayan	3.75	3.00	3.37				5.50	5.50	5.50
Capiz	3.75	1.50	2.62	20.00	7.00	13.50	7.00	4.00	5.50
Cavite	3.00	2.50	2.75	18.00	16.00	17.00			
Cebu	4.37	2.00	3.18	18.00	11.00	14.50	11.00	6.00	8.50
Ilocos Norte	5.00	3.00	4.00						
Ilocos Sur	6.25	2.50	4.37						
Iloilo	3.60	2.31	2.95	20.00	18.00	19.00	7.00	6.50	6.75
Isabela	4.75	4.75	4.75						
La Laguna	3.50	2.25	2.87	10.50	5.00	7.75	5.80	4.80	5.30
La Union	4.00	1.75	2.87				8.00	6.00	7.00
Lepanto-Bontoc	4.00	3.00	3.50				3.00	3.00	3.00
Leyte	3.50	2.50	3.00	15.00	4.00	9.50	7.50	4.50	6.00
Mindoro	2.50	2.50	2.50	10.00	10.00	10.00	4.50	4.50	4.50
Misamis	3.75	2.00	2.87	16.50	7.50	12.00	7.50	6.00	6.75
Moro	2.50	1.50	2.00	14.50	6.50	10.50	7.00	6.00	6.50
Nueva Ecija	3.00	1.25	2.12						
Nueva Viscaya	3.12	1.50	2.31						
Occidental Negros	3.50	2.00	2.75	17.00	11.00	14.00	7.10	5.00	6.05
Oriental Negros	3.25	2.00	2.62	14.00	2.00	8.00	7.60	6.00	6.80
Palawan	2.50	1.50	2.00				5.50	5.50	5.50
Pampanga	2.70	2.00	2.35						
Pangasinan	4.00	2.00	3.00				8.00	2.50	5.25
Rizal	3.00	2.50	2.75				4.50	4.50	4.50
Samar	3.50	2.25	2.87	14.00	10.00	12.00	6.50	5.25	5.87
Sorsogon	3.25	2.50	2.87	16.00	6.00	11.00	7.00	2.50	4.75
Surigao	5.00	2.50	3.75	14.00	10.00	12.00	7.00	6.00	6.50
Tarlac	2.75	1.50	2.12						
Tayabas	5.00	2.00	3.50	18.00	5.00	11.50	5.50	3.50	4.50
Zambales	3.12	2.00	2.56				4.00	4.00	4.00

Highest, lowest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the month of October, 1908—Continued.

Province.	Sugar, per picul.			Tobacco, per quintal.			Corn, per cavan.		
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Agusan				₱1.50	₱1.00	₱1.25	₱2.00	₱1.50	₱1.75
Albay	₱8.00	₱4.00	₱6.00				5.00	3.00	4.00
Ambos Camarines	8.25	2.00	5.12				4.00	1.00	2.50
Antique				32.00	6.00	19.00	2.50	2.50	2.50
Bataan	4.00	4.00	4.00				1.75	1.00	1.37
Batangas	4.00	3.00	3.50				3.90	2.00	2.95
Benguet	5.00	4.00	4.50				4.00	4.00	4.00
Bohol	4.00	4.00	4.00	20.00	15.00	17.50	4.00	1.00	2.50
Bulacan	5.50	4.50	5.00	15.50	9.00	12.25	2.75	1.50	2.12
Cagayan	6.00	2.00	4.00	15.00	6.00	10.50	3.00	1.75	2.37
Capiz	5.00	5.00	5.00	15.00	15.00	15.00	2.50	2.00	2.25
Cavite	3.70	3.70	3.70				2.25	2.25	2.25
Cebu	8.00	2.00	5.00	27.00	4.00	15.50	3.75	2.00	2.87
Ilocos Norte	5.00	4.00	4.50	19.00	4.00	11.50	5.00	2.50	3.75
Ilocos Sur	6.00	3.50	4.75	35.00	8.00	21.50	5.00	3.00	4.00
Iloilo	6.00	4.00	5.00	30.00	5.00	17.50	4.00	2.50	3.25
Isabela				14.00	14.00	14.00	3.00	3.00	3.00
La Laguna	4.50	3.00	3.75				3.00	2.50	2.75
La Union	7.50	4.50	6.00	8.00	8.00	8.00	3.00	3.00	3.00
Lepanto-Bontoc	2.50	2.50	2.50	4.00	4.00	4.00	5.00	3.00	4.00
Leyte	4.50	3.50	4.00	45.00	15.00	30.00	5.00	2.00	3.50
Mindoro									
Misamis	4.50	4.00	4.25	12.00	12.00	12.00	3.50	1.50	2.50
Moro	5.25	5.25	5.25				2.50	2.00	2.25
Nueva Ecija	7.50	5.00	6.25	32.00	4.00	18.00	2.25	1.50	1.87
Nueva Viscaya				20.00	20.00	20.00	2.00	2.00	2.00
Occidental Negros	5.25	3.00	4.12	35.00	30.00	32.50	2.50	1.60	2.05
Oriental Negros	5.00	3.00	4.00	25.00	6.70	15.85	5.00	2.50	3.75
Palawan				20.00	20.00	20.00			
Pampanga	5.00	3.50	4.25				2.50	2.00	2.25
Pangasinan	7.00	3.00	5.00	55.00	5.50	30.25	5.00	1.00	3.00
Rizal							5.00	5.00	5.00
Samar	5.00	5.00	5.00	6.00	6.00	6.00	4.00	1.50	2.75
Sorsogon	5.00	1.50	3.25	10.00	10.00	10.00	4.00	1.50	2.75
Surigao	4.00	4.00	4.00	17.00	15.00	16.00	2.00	1.50	1.75
Tarlac	5.00	4.00	4.50	8.00	6.50	7.25	2.00	2.00	2.00
Tayabas	6.25	4.00	5.12	8.00	5.00	6.50	3.00	1.25	2.12
Zambales	8.00	6.25	7.12	25.00	25.00	25.00	2.00	2.00	2.00

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Bureau of Agriculture.

SEED AND PLANT DISTRIBUTION.

MAGUEY PLANTS.

Maguey plants will be distributed free of charge to parties requesting them, for their own use, as follows:

200 Hawaiian sucker plants, or
400 native sucker plants.

Parties wishing larger quantities will be required to pay for them at the following rates:

	Per 1,000.
Hawaiian sucker plants	₱10.00
Native sucker plants	6.00

Parties ordering plants not on the free list should send post-office money order for the amount of purchase.

Literature on the subject of maguey growing in the Philippine Islands can be secured from the Bureau of Agriculture.

KAPOK.

The Bureau of Agriculture now has a large supply of *Kapok* seedlings, which will be distributed without charge to persons making application for the same. Applications should be made at once so that the trees can be set out before the close of the present rainy season.

GUINEA GRASS.

Roots of this valuable forage plant will be furnished upon application. Guinea grass requires a rather high temperature, plenty of sunshine, and a soil that while moist is not too wet. Unless planted in a well-drained soil, the roots of this grass should not be set out until near the end of the rainy season.

MULBERRY.

A limited supply of mulberry cuttings can now be furnished to persons interested in the growing of silkworms.

Applicants for seeds or plants are requested to write name and address clearly, and to give full shipping directions for any material that can not be sent by mail. All communications should be addressed to the Director, Bureau of Agriculture, Manila, Philippine Islands.

G. E. Nesom, *Director of Agriculture.*

PLATE I.

THE PHILIPPINE

Agricultural Review

VOL. I | DECEMBER, 1908 | NO. 12

CONTENTS AND ILLUSTRATIONS.

CONTENTS.

ILLUSTRATIONS.

EDITORIAL.

PASSING THE FIRST MILE STONE.

With this edition THE PHILIPPINE AGRICULTURAL REVIEW has passed the first year of its existence as a monthly periodical. It was an experimental venture for the Philippines, but not an entirely new idea in agricultural literature. Many of the departments of agriculture, experiment stations, and botanic gardens publish periodic bulletins, journals, and reviews in a variety of forms. Our endeavor has been to make THE PHILIPPINE AGRICULTURAL REVIEW a good journal of its class. Those who have read it regularly know the success we have attained better than we can explain.

In looking over a large list of exchanges which we now receive regularly it is only a fair conclusion to say that this journal ranks with the best

of its kind. It also enjoys the unique distinction of having the largest circulation, both domestic and foreign, of any periodical published in the Archipelago. The Bureau of Printing has rendered very valuable service and is due full credit for the excellent typographical work done in the production of the REVIEW. During the past year several numbers have appeared late. This has been due to the large amount of public printing always on hand and to the fact that no provision has been made for a special editorial staff for the REVIEW. The work has been done by the regular force of this Bureau. Additional help will be employed during the coming year.

INDEX TO VOLUME I.

Those who have received the REVIEW regularly have now had sufficient time and opportunity to determine whether or not it is worth binding and keeping. For the benefit of those who may think so we are preparing and will in the near future publish a complete table of contents and index to Volume I, in both English and Spanish. This index will be mailed only to libraries and institutions which are likely to bind and preserve their files. However, a few extra copies will be printed and others who desire to bind their copies may obtain the index by writing for it, until the edition is exhausted.

THE NATIONAL CONSERVATION COMMISSION.

The appointment and work of the National Conservation Commission of the United States will go down in the history of agricultural industry and rural economics as a monument to the broad-minded, constructive statesmanship of President Roosevelt. This number of the REVIEW includes an article giving a brief insight into the work of the four sections and executive committee of this Commission and the State, Territorial, and insular commissions. As indicated in the last paragraph of this article, President Roosevelt will probably transmit the report of the Commission to Congress as one of his last official acts as President, and will include in his message many important recommendations for the conservation of the natural resources of the United States. The nature and importance of this subject is such that the present movement is merely a precursor of a systematic effort on the part of the American people to conserve their natural resources in order that America may remain the leading nation of the world. This movement was intended to cover all of the States, Territories, and insular possessions. Most of the States and the Hawaiian Islands have appointed commissions which are at work. Unfortunately, up to the present time, none has been appointed for these

Islands, which appear not to have been represented at the White House conference last May. It is hoped that action will be taken in the near future looking to the provision for such a commission for the Philippines.

THE COCONUT INDUSTRY.

The coconut is one of the staple crops of the Philippine Islands and its products rank among our leading exports. Anything that affects the coconut tree correspondingly affects the coconut industry and exports from these Islands. When it became known, some months ago, that bud-rot of the coconut existed in the Provinces of Laguna and Tayabas some apprehension was felt for fear that the coconut industry would receive a severe blow as a result of the ravages of this disease. By mutual consent of the Bureaus of Agriculture and Education the latter undertook an investigation, through the agricultural teaching force, of the extent of this invasion. The results of this investigation were published in the May number of the REVIEW (pp. 210 to 220).

As this disease prevails in many other tropical countries articles relative to it were brought to the attention of the Government officials here, who thought the subject worthy a second and more thorough investigation as to the nature and extent of the disease. Mr. A. F. Byars, agricultural inspector of this Bureau, was detailed on the work and proceeded to the Provinces of Laguna and Tayabas early in the month of October. He has now concluded his investigations, returned to Manila, and submitted his report.

It is safe to say that while the disease exists and is quite fatal to the coconut tree, it does not seriously endanger the industry. It appears to have been in both provinces for more than ten years, but the number of trees affected by it up to date is insignificant as compared with the number growing. It is worse in the high lands far removed from salt water than elsewhere.

During his investigations, Mr. Byars became so thoughly interested in coconut growing that he has prepared an article on the subject which appears in this number of the REVIEW. We are also printing an article on the coconut industry in British Guiana, taken from the Journal of the Board of Agriculture of British Guiana, Volume II, No. 1.

THE NATIONAL CONSERVATION COMMISSION.

Compiled by G. E. NESOM, *Director of Agriculture.*

One of the most noteworthy events of recent times was the appointment by President Roosevelt of the National Conservation Commission of the United States. To the President belongs the principal credit for the ideas which led up to its formation. He appointed the Inland Waterways Commission in March, 1907. It reported to him on February 3, 1908, and he transmitted this report to Congress on February 26, together with a message suggesting that the recommendations of the Commission be enacted into law. The work of the Commission had developed the wide-reaching importance of the waterways problem, and had taken up the relation of the waterways and the water supplies of the country to all of the natural resources affected. It brought into prominence the great need of conserving, not one or a few, but all of the natural resources of the country. At the suggestion of the Inland Waterways Commission, in order more fully to consider the far-reaching problems of conservation, the President, early last winter, invited the governors of the different States and Territories to a conference in Washington to consider the whole question. Men of national prominence, familiar from experience in business life with the four great classes of resources—the forests, waters, mines, and the soil—were also invited to the conference. The conferees met at the White House May 13 to 15, 1908, and before adjournment the governors signed a declaration of broad principles regarding the importance, value, and conservation of these natural resources of the United States. In his opening address before this convention, President Roosevelt said—

> The wise use of all our natural resources, which are our national resources as well, is the great material question of to-day.
>
> Disregarding for the moment the question of moral purpose, it is safe to say that the prosperity of our people depends directly on the energy and intelligence with which our natural resources are used. It is equally clear that these resources are the final basis of national power and perpetuity. Finally, it is ominously evident that these resources are in the course of rapid exhaustion.

There were present at this conference many noted men representing every part of the nation. They came to speak in behalf of principles and policies which are destined to have an important bearing on the

future history of the great American nation. They discussed the effect that will be produced upon the nation by the destruction of its forests at a rate which will leave future generations almost without timber; by the washing away of land denuded of forests; by the flooding of streams when the forest influence on stream flow is removed; by the constant waste of water supplies representing incalculable value for irrigation, power and navigation purposes; by the filling of streams and harbors with the soil eroded from lands denuded of forests; by the exhausting of the soil through erosion; by the covering of valley lands with sand and clay washed down from bare hills; by failure to rotate crops and apply fertilizing agents, and by the wasteful methods now so commonly applied in the mining, manufacture and use of such valuable mineral resources as coal, iron, petroleum, and natural gas.

They commended the wise foresight of President Roosevelt in calling the convention, made strong recommendations to the Federal Congress regarding the enactment of laws for the conservation of the natural wealth of the country, and urged the immediate adoption of strong national policies which will guarantee the preservation of these foundations of wealth, prosperity and power in perpetuity for the benefit of the American people as a nation.

They agreed that further action should be taken by the formation in each State and Territory of commissions which should coöperate with one another and with a Federal Commission for the conservation of the natural resources of the United States.

On June 8, 1908, President Roosevelt sent out a letter appointing the National Conservation Commission, which he stated should be organized into four sections to consider the four great classes of natural resources—water, forest, land and mineral. The Inland Waterways Commission was continued as the section on water resources. This section consisted of twelve members and a like number was appointed on each of the other three sections. He also named an executive committee of nine members selected from the four sections of the Commission. He then defined the duties of the Commission as follows:

One of the principal objects of the Federal Commission on the Conservation of Natural Resources will be to coöperate with corresponding commissions or other agencies appointed on behalf of the States, and it is hoped that the governors and their appointees will join with the Federal Commission in working out and developing a plan whereby the needs of the nation as a whole and of each State and Territory may be equitably met.

The work of the Commission should be conditioned upon keeping ever in mind the great fact that the life of the nation depends absolutely on the material resources, which have already made the nation great. Our object is to conserve the foundations of our prosperity. We intend to use these resources; but to so use them as to conserve them. No effort should be made to limit the wise and proper development and application of these resources; every effort should be made to prevent destruction, to reduce waste, and to distribute the enjoyment of

our natural wealth in such a way as to promote the greatest good of the greatest number for the longest time.

The Commission must keep in mind the further fact that all the natural resources are so related that their use may be, and should be, coördinated. Thus, the development of water transportation which requires less iron and less coal than rail transportation, will reduce the draft on mineral resources; the judicious development of forests will not only supply fuel and structural material, but increase the navigability of streams, and so promote water transportation; and the control of streams will reduce soil erosion, and permit American farms to increase in fertility and productiveness and so continue to feed the country and maintain a healthy and beneficial foreign commerce. The proper coördination of the use of our resources is a prime requisite for continued national prosperity.

He closed his instructions to the Commission by saying:

Hearty coöperation between the State and the National agencies is essential to the permanent welfare of the people. You, on behalf of the Federal Government, will do your part to bring about this coöperation.

In order to make available to the National Conservation Commission all the information and assistance which it may desire from the Federal Departments, I shall issue an Executive Order directing them to give such help as the Commission may need.

The next session of Congress will end on March 4, 1909. Accordingly I should be glad to have at least a preliminary report from the Commission not later than January 1 of next year.

PROCEEDINGS OF THE PHILIPPINE VETERINARY MEDICAL ASSOCIATION, MANILA, SEPTEMBER 28 TO 30, 1908.

TICK ERADICATION.

Dr. J. E. Nance, *Veterinarian, Bureau of Agriculture.*

The subject of tick eradication has received considerable attention of late from the United States Department of Agriculture, an appropriation of some $250,000 having been secured from the last Congress to carry on the work, which was begun about two years ago. It was indeed quite an undertaking and was looked upon somewhat as an experiment at first, but results have been so favorable that the work will doubtless be carried on from year to year until finally the tick which causes such an enormous annual loss to the cattle raisers will be entirely eradicated from the districts which are now quarantined on account of it.

Having had some experience as an inspector in the tick eradication work, I will give in this paper a brief outline of the methods used, not attempting any scientific discussion of Texas or splenic fever, believing that this is fairly well understood by veterinarians and others who have had experience along this line.

When the Secretary of Agriculture decided to start this work, all qualified veterinarians who could be secured were given appointments.

Enough, however, could not be obtained, and to make up the number of men needed laymen who were designated as "agents" in tick eradication were appointed to work along with the veterinary inspectors.

Of course in such work as this there must be a State law to work under, as the Federal Government can do nothing within a State without its consent and coöperation. After the necessary laws were passed by the several legislatures of the infested States the Department of Agriculture agreed to coöperate with the live-stock sanitary boards and to furnish as many inspectors as they. In some cases, however, the Government furnished more.

When they were ready to begin operations, a certain territory bordering on the interstate quarantine line was selected over which to work. Inspectors were sent out to make a canvas from farm to farm and examine all cattle. If even one tick was found the entire herd involved was quarantined by giving the owner or occupant a written notice to allow

no cattle to be brought into or taken away from the premises without written permission from an inspector.

When all the pastures in each section had been gone over and the infested places determined, reinspections commenced. In making these reinspections one veterinarian and one agent generally rode together and covered an area of territory which could be gone over in about three weeks. Under the Oklahoma law the owner of quarantined cattle is required to dip or grease them in crude petroleum every twenty days and in case he neglects or refuses to do so the inspector may notify the sheriff who will have it done, charge to the owner, and hold his cattle until the bill is paid. Where there are only a few head of cattle the greasing process is done with a rag or sack dipped in crude oil and rubbed completely over the animal. This kills all ticks on the body and also prevents others from crawling on for several days. In this way no ticks are allowed to develop and fall off to lay eggs and hatch, thus increasing the numbers. Nearly any of the crude oils will kill the tick, but some have been found to be very irritating to the skin, causing very bad blisters, making the animal very sore, and sometimes even resulting in death. The oils from the wells at Beaumont, Texas, and Humboldt, Kansas, are the only ones so far which have been specially recommended for this purpose, on account of containing a large proportion of sulphur and a small percentage of petroleum. Where the crude oil can not be readily procured and only a small amount is needed, a mixture may be made of one gallon each of refined petroleum and lard and one pound of sulphur, which kills the ticks very satisfactorily, but it is more expensive than the crude oil. Where the dipping or greasing is kept up regularly and no ticks are allowed to mature, a pasture can be easily cleaned in one year.

Opposition to the work is often met with among the more ignorant class of people and this constitutes the greatest hindrance. All who oppose the tick-eradication work have some sort of argument to bring forth and here is where the value of the veterinarian is greater than that of the layman. With his scientific knowledge of Texas fever and other animal diseases he is able to answer the many questions that are asked of him and thus gains the confidence of the cattle owners, which is absolutely essential if the work is to be successful. Also it is very necessary that the inspector be able to differentiate between fever ticks and other species which infest cattle. In my experience I have found at least three different species on the same animal. All the native Philippine cattle and those imported from China, I believe, are or have been infested with fever ticks and are therefore immune to Texas fever.

The *Boophilus australias*, which is the tick found here, is somewhat rounder and of a darker color than the *Boophilus annulatus* of the United States. I have noticed that as the weather grows hotter and dryer

in the States the ticks seem to decrease in numbers, and am led to believe that this condition is detrimental to the hatching process.

In the Philippines, where there are no fences and it is so difficult to maintain a quarantine, the eradication of the fever tick would be almost an impossibility. However, it seems that the immunizing of nonimmune cattle to be imported here could be practiced very profitably. This is now done in the United States at a loss of from 5 to 10 per cent, whereas when nonimmune cattle are shipped below the quarantine line without being immunized the loss is from 90 to 100 per cent.

Ticky cattle from Texas are now shipped by the thousands to the pastures north of the quarantine line in Oklahoma. The regulations provide that they must be dipped in crude oil under the supervision of a veterinary inspector of the Bureau of Animal Industry before being allowed to go to the grazing lands. The railroad companies have built vats at different stations for this purpose and the cattle are driven direct from the cars through the vats where they are completely submerged. Sometimes weak thin cattle when thirsty will drink enough oil while passing through the vat to cause death. To prevent this loss an order was issued that all cattle be given a sufficient quantity of water to quench their thirst within six hours before dipping.

In conclusion, I wish to say that the eradication of the fever tick is practical and possible and will mean thousands of dollars to the Southern farmers and stockmen. The authorities interested are to be congratulated upon the progress that has been and is now being made in this great undertaking, for its achievement will mark an epoch in the elimination of disease by quarantine sanitation.

ZOÖTECHNIC, VETERINARY, AND EPIZOÖTIC SERVICE OF INDO-CHINA.

Read by Dr. CHARLES G. THOMSON.

[Translation of article furnished by the veterinary authorities of Indo-China.]

ORGANIZATION—GENERAL WORKINGS.

Since the reorganization of the zoötechnic, veterinary, and epizoötic service of Indo-China in 1901 this work has been performed by a corps of veterinary surgeons belonging to Indo-China, having an organization of its own, with classes, scale of salaries, and right to pension upon retirement, payable from the local funds of the colony.

By the organic decree of November 13, 1901, a veterinary service was established in each of the countries of Indo-China, placed under the authority of the lieutenant-governor, the superior residents, or the commanders in chief of the military territories, and under the technical direction of a veterinary surgeon performing the duties of chief of the zoötechnic, veterinary, and epizoötic service, attached to the department of agriculture, forestry, and commerce.

The veterinary surgeons are charged, under the laws, regulations, and decrees in force, with the supervision of the sanitary condition of cattle, the application of preventive and curative measures against contagious diseases, and, in general, with the study of all means tending toward the preservation of domestic animals, that is, with the propagation and application of zoötechnic methods.

The veterinary personnel of the local service has the following ranks and salaries (colonial):

Probational	$1,200
Class 5	1,400
Class 4	1,600
Class 3	1,800
Class 2	2,220
Class 1	2,650

In addition, the veterinary inspectors are entitled to fixed travel and removal allowances based on the importance and extent of their territories, as recommended by the chief of administration of the locality.

The civil personnel of the veterinary service is appointed by decree of the governor-general on the joint recommendation of the chief of local administration and the director of agriculture, forestry, and commerce.

The probational veterinary inspectors are recruited from among the graduates of the national veterinary school of France. The veterinary inspectors of class 5 are chosen from among the probational appointees who have passed a period of at least two years in Indo-China, or from among the French veterinary surgeons who have practiced for ten years in France or in the colonies.

The veterinary surgeons of classes 4, 3, 2, and 1 are selected from the class immediately below the one to which they are appointed, after two years service in such class for promotion to classes 4 and 3 and after three years, for promotion to classes 2 and 1.

Besides, native veterinarians and inoculators assist the veterinary inspectors in each of the countries of Indo-China. They are appointed by decree of the chief of local administration after a period of probation. They are chosen preferably from among the natives having a sufficient knowledge of the French language to enable them to serve as interpreters.

With a view to aiding the veterinary inspectors in a still more effective manner in the performance of their duties, Governor-General Beau, by decree of October 25, 1904, added a native veterinary medical section to the school of medicine at Hanoi.

The decree of November 1, 1901, which merely outlines the organic bases of the service, has been very happily completed by Governor-General Beau in his decrees of November 17, 1905, and April 24, 1907, defining the operation of the zoötechnic, veterinary, and epizoötic service in Tonkin and Annam.

The last-named decrees, though concerning only Tonkin and Annam at the present time, are to be applied successively to the other countries of Indo-China as soon as they have acquired the personnel necessary to properly carry on the work. These decrees contain the following provisions:

The Provinces of Tonkin are grouped into six veterinary districts (this number has been increased to ten in the appropriation bill for 1907). The Provinces of Annam are grouped into four veterinary districts. In each district a veterinary inspector is required to attend to the zoötechnic, veterinary, and epizoötic service under the technical direction of the chief of the service, with the department of agriculture, forestry, and commerce. Under the authority of the chief of local administration he is charged with the following duties:

1. The supervision of the breeding establishments of the Government, or those subsidized by the Government, such as stud farms, etc., and, in general, of all establishments in connection with the breeding of stock or with the cattle industry.

2. The sanitary supervision of domestic animals. Within his district the veterinary inspector proposes to the provincial chiefs all such administrative measures as he may deem useful in cases of epizoötics. He himself does what is necessary as regards the treatment of sick animals, and reports it to the chief of the zoötechnic, veterinary, and epizoötic service.

To this end he has the privilege of using the mails and telegraph free of charge in communicating with said officer, and also with the administrators who are chiefs of provinces in his district, or their deputies, and with the veterinary surgeons of other districts.

He inspects the sanitary conditions of cattle by means of periodical tours for this purpose, the time and itinerary of which he regulates in accordance with the instructions of the chief of the zoötechnic, veterinary, and epizoötic service. The administrators in charge of provinces render him assistance in the performance of his official duties.

INSTRUCTIONS TO VETERINARIANS.

(1) *Reports.*—In ordinary times, that is, in the absence of epizoötic or suspicious diseases, only monthly and annual reports will be made, on special blanks which are furnished you herewith. The zoötechnic part of the service will be the subject of a separate report rendered at the same time. The monthly reports will be sent on the first and fifth of the month, but may be postponed if at this time you should be absent on official business.

The cases of disease of which you are called to take charge shall be made the subject of one or more reports, according to circumstances, which must be forwarded to the central office as soon as possible. In

making these reports you will please follow the instructions given on the printed forms. I insist especially upon the necessity of giving the reasons for the diagnosis with all possible precision, particularly relating to such diseases as might entail financial responsibilities on the administration.

It is left to you in what order you make your tours of inspection. If your absence is liable to be for a long time you will kindly inform me previously, stating in a brief manner the itinerary adopted.

(2) *Relations with the veterinary surgeons of other districts.*—It does not appear that in ordinary times the official relations between the several chiefs of districts are very close. You are allowed full latitude in this respect. It is important that the migrations of the herds be watched by common accord, and you should furnish your colleagues with all the information which they may request on matters of interest to the service, whatever these may be.

This obligation of mutual assistance shall be still more rigorous in times of epizoöty, and each chief of district shall advise his colleagues in the adjacent districts of the existence of any disease which might prove a danger to their respective districts, communicating to them all useful information.

(3) *Relations with the local authorities.*—The veterinary sanitary police service can not be performed effectively without the assistance of the local authorities, and it is therefore important that you remain in constant touch with these officials.

In the course of your tours of inspection it is very advisable for you to present yourself to the administrators or their deputies, and to the chiefs of isolated posts, in order to inform them of your presence in the region and to obtain all useful information regarding sanitary conditions or cattle breeding. I believe that this plan should be followed constantly.

Furthermore, every case of suspicious disease found by you must be the subject of a communication to the nearest local authority. This communication may be simple, either verbal or in writing, according to circumstances, though the latter is to be preferred. The administrator in charge of the province has exclusive authority to order the enforcement of the sanitary measures proposed by you, and the deputy chiefs and post commanders are required to comply with his instructions.

As a rule, the majority of the deputies or post commanders will apply the most urgent measures proposed by you on the spot, but it is very evident that you must immediately advise the chief of the province of the facts established and the measures necessary.

You will kindly attend to all regular requests of the local authorities and make all sanitary visits asked by them with the greatest celerity.

It is your duty to visit and attend to the animals belonging to the administration (stallions or mares of the zoötechnic service, horses of the residencies, and of the native guard) without any special allowance

or compensation, but this is limited to the animals of the protectorate and does not include those of the Army or of officials with an allowance for mounts. In all cases the medicines and dressings are charged to the persons interested.

The local authorities must furnish you with all the agents necessary for carrying out proper sanitary measures, escorts, guards, etc. It will be necessary for you to arrange this matter with them.

In the event of its being impossible for you to obtain for yourselves the means of transportation, vehicles, and coolies, you may request said authorities to assist you in doing so.

(4) *Relations with European stock owners.*—In ordinary times it will be necessary to visit the herds of the colonists, as much for the purpose of ascertaining their sanitary condition as in order to study the breeding methods and follow the results obtained. Visits of this kind are generally welcomed and even requested by the majority of the proprietors, but they may object to them, and no law permits disregarding their objection. It is therefore necessary, in order to avoid disagreeable incidents, that you communicate with the cattle breeders before you present yourselves at their places. However, those proprietors with whom the administration has left studs and those who keep cross-breeds or other animals liable to earn them official prizes for live-stock breeders, should not object to the visiting of the animals mentioned, over which the administration has an indisputable right of control.

This visit should be made with the greatest care and you will have to verify the statements of the proprietors, using in this work all the discretion compatible with its proper execution. The result of these observations will be set forth in your monthly report on live-stock breeding, and mention of your visit will be made on the register of the stock breeder.

You should furnish the proprietors with all the information which they may desire regarding cattle breeding, veterinary hygiene, and zoötechnic work. You will thus be able to render important and much appreciated services.

Aside from the use of the serums or vaccines which the administration may find it possible to furnish, you are in no wise obliged to treat animals belonging to private citizens.

Whenever an epizoötic has been reported or is suspected in any herd and a request to visit the same has been transmitted to you by the administrator in charge of the province, the proprietor can not object to such a visit and you are bound to comply with the request. Requests made by proprietors in any other form may be considered by you as null and void.

Outside of urgent cases where first aid is indispensable, no medicine, disinfectant, or dressing of any kind shall be delivered to the proprietors. Injections of anti-rinderpest or anti-anthrax serum shall not be made

except in cases of well established necessity, of which you are the sole judge. The high price of these products should limit their use and does not permit of their being expended in a prodigal and careless manner.

(5) *Relations with the natives.*—In a general manner the administrators will give the native authorities instructions to facilitate your work in the villages. It is very important that all the *ly-truong* should know that they must place themselves at your disposition, if necessary.

It will be very useful, after having come to an understanding with the local authorities, to assemble all the cattle in order to inspect them, and in the event of unwillingness on the part of the *ly-truong* or the notables it is for the administrators to impose punishment.

I invite your attention to the necessity of taking as exact a census as possible of the resources of your district in live stock of all kinds, but in order not to frighten the natives this census must be taken in a discreet manner. The results will not be very precise, necessitating subsequent investigations and it will not be until after several years that it will be possible, thanks to this uninterrupted practice, to obtain sufficiently exact data.

It would be well to improve every opportunity for demonstrating to the natives the utility of good sanitation, in proportion to their means, and however poor the results obtained at the outset may be, this must not be neglected. In cases of epizoötics instructions as simple as possible should be given to the mandarins, chiefs of cantons, and communal authorities, through the administrators, who have all the powers necessary to insure their execution.

Certain provinces have had small appropriations for the purchase of medicines and disinfectants, which are distributed gratuitously among the natives in cases of epidemics or epizoötics. You will probably be able to induce all the chiefs of provinces in your district to adopt this practice, which will result in the greatest benefit to the people governed by them and guided by your advice.

(6) *General course of the service.*—It is important that every veterinary inspector should thoroughly know the district of which he has charge, and for this purpose he should tour it frequently. At least once every three months you should visit all the head towns of provinces, centers of deputations, isolated posts, important markets, and European concessions. These tours are made at periods not fixed and (except in so far as they concern certain property of Europeans, as you have seen further back) left to your choice.

F. LEPINTE, *Chief Veterinarian.*

After reading this paper, Dr. Thomson continued as follows:

Just a few words in regard to the general work and life of the veterinarians. In their field work—the suppression of rinderpest, surra, and other diseases—they have many advantages over the men here, tending

toward speedier and more successful termination of outbreaks. In the first place, the permanent location of veterinarians in districts is a favorable factor, as they are able quickly to cope with anyting that develops. The possession of well-equipped laboratories, good transportation facilities, and their geographical and social knowledge of the districts are all of great value. Then, too, as I have tried to show, the laws relating to the suppression of infective diseases are almost ideal, including those of France, but in addition prescribing the slaughter of animals found suffering from the tropical diseases—surra, rinderpest, etc. And I might mention also that the policy in effect there, being one of government by the French and essentially for the French, permits an autocratic handling of affairs that certainly tends toward efficiency in the work of the veterinary corps, whatever may be said of it in other respects.

The work of the men in Indo-China is not confined so much to sanitary science as here, but consists largely in supervision over the breeding stations, inspection at abattoirs, and general practice among the Government stock in the colonies. Each is given a house in which to live, for which he pays a certain proportion of his salary (about 2 per cent). The examination for positions, I am told, is very severe, as this branch of the service is considered the best berth in the French Government work. As you have heard, the salaries are large, especially from the European viewpoint, and opportunities for advancement considerable, so some of the best of the French veterinarians come to Indo-China. To induce a long service, pensions are given after certain periods of time, the basis being a percentage of the salary upon retirement, increasing with the length of time in the service. This is one of the best of the many pleasant features of the service in Indo-China, and one which employees of our Government can anticipate if the present sentiment in Congress does not lapse.

I had no opportunity to observe the handling of rinderpest while there, as none existed in the country. In fact, the disease has not been common for some years, since the colonial authorities legislated against the importation of cattle from China. Prior to that time, the country had been, as the governor told me, a "sewer," into which Unamese rinderpest animals had been dumped, but following the imposition of quarantines at the ports and along the frontier the disease has almost entirely disappeared. However, when an outbreak of rinderpest or other infectious disease occurs, the animals infected or exposed are destroyed at once, all stables, fences, etc., disinfected, and all the cattle in the neighborhood inoculated. Quarantines are suggested and outlined by the veterinarian, but there his responsibility in this respect ends, as the administrative branches of the government are responsible for their maintenance. You who have experienced the pleasures of trying to maintain quarantines in the provinces know what a load of trouble is taken from the veterinarians by this plan.

And as to the different serums used and their preparation, antirinderpest serum is made at the Pasteur Institute and sold by it to the government. Of course, being a private institution, considerable profit is derived from its manufacture, resulting in the colony's paying about twice as much per cubic centimeter as it costs the Bureau of Agriculture in these Islands. They economize by injecting but 20 cubic centimeters, giving a resultant immunity of about three week, which is considered sufficient to carry animals through outbreaks as they are handled at present. The only other serum made in any considerable quantity is that for septicemia hæmorrhagica, and this is not very much in demand, nor is it of high immunizing value.

VACCINATION TREATMENT FOR HOG CHOLERA.

By Dr. B. A. SEELEY, *Veterinarian, Quartermaster's Department.*

In discussing hog cholera we will assume the dual cause, that is, the *bacillus cholera suis* and the invisible virus. We shall have to admit that it is contracted chiefly by ingestion and that it is more common at certain seasons of the year than at other seasons.

The following vaccination treatment is founded upon the fact that an animal having survived an attack of hog cholera is immune for some time after the attack. If the blood of this immune hog is injected into a susceptible hog and that hog is exposed to cholera, either by being in an infected place or by artificial inoculation, this hog will possess an immunity of from one month to a year or more, depending upon the amount of serum injected to produce the immunity and the amount of virulent blood injected to intensify the resisting powers.

As Dr. Niles explained it to me, the serum is obtained from a hyperimmunized animal. This animal is bled at frequent intervals by cutting off a small portion of the tail and at last the hog is killed and all the blood is saved. The blood is defibrinated and a small percentage of phenol is added to preserve the serum.

The virulent blood that is injected to intensify the resisting powers, where natural exposure can not be had, is obtained from an animal in an active stage of cholera.

The seat of vaccination may be optional, but a very convenient method is to have an assistant hold the animal by the hind legs and insert the needle about three inches from the median line.

The dose depends upon the size of the animal and the strength of the serum.

INFORMATION ON RICE CULTURE IS DESIRED.

The following circular has been sent to all the presidentes in the rice-growing provinces. The object in sending out this circular is to collect as much information as possible as to the number of varieties, and to determine the extent to which certain varieties are grown.

The Bureau would appreciate it if the teachers would have a list made out by the school, giving the data asked for in this circular and forward it to the Director. We also ask the coöperation of any others who are interested in agriculture.

When a collection has been made of these different varieties and a test made, the Bureau will be glad to furnish those who have helped us to make this collection, with samples of the varieties they desire.

Answer the questions by number and make a list of the varieties grown in your locality, using headings as shown in the table at the bottom.

Do not forget to give your name and address.

MANILA, *December 9, 1908.*

SIR: In view of the fact that rice is one of the most important and indispensable products of this country, the Bureau of Agriculture is devoting considerable time to methods of culture and varieties. We request that you answer the list of questions given below and fill out the blank form, giving the names of as many varieties as possible.

1. A complete list of all varieties or classes of rice that are found in your municipality, for which the attached blank sheet should be filled out.

2. Show, in order of importance, which of these varieties or classes are most extensively or commercially cultivated. Give reasons why.

3. How many crops of rice can be harvested from the same piece of land each year in your municipality? If more than one, say which one of the crops produces the most in proportion to the seed used.

4. In what months is rice (*a*) planted and (*b*) harvested, in your municipality?

5. An approximate estimate of the expenses that would be incurred in the cultivation (preparation, planting, transplanting, irrigation and cleaning) of one hectare of land (3.576 balitas) planted with—

(*a*) Lowland rice, first planting .... ₱
(*b*) Lowland rice, second planting ....
(*c*) Upland rice ....

6. An approximate estimate of the necessary expenses to re-collect the crop (harvesting, stacking, and threshing) from one hectare of land in your municipality.

7. A short description of the method or methods employed in the—

(*a*) Preparation, planting, transplanting, and cultivation.
(*b*) Harvesting, threshing, etc.

8. How many cavanes of palay does a cavan of seeds of 25 gantas produce in an average season:

(*a*) Inferior.

(*b*) Medium.

(*c*) Superior.

9. Minimum price of (*a*) unhulled rice, (*b*) hulled rice; maximum price of (*a*) unhulled rice, (*b*) hulled rice.

10. In what months of the year is the price the best for—

(*a*) Unhulled rice.

(*b*) Hulled rice.

11. In what months of the year is the price the lowest for—

(*a*) Unhulled rice.

(*b*) Hulled rice.

This investigation is independent of the work of the division of statistics of this office.

Kindly give this your early attention.

Thanking you in advance we remain,

Very respectfully,

G. E. NESOM, *Director*.

To the MUNICIPAL PRESIDENTE,

....

Town .... Province ....

Date ....

Name of rice.		Bearded or unbearded.	Color of unpolished rice (white or red.)	Glutinous or non-glutinous.	Number of days to maturity.	
Lowland.	Upland.				From planting.	From transplanting.

THE ANNATTO PLANT.

By C. M. CONNER, *Assistant Director of Agriculture.*

The annatto plant, known locally as achuete, grows throughout most of the islands and does well on any fairly rich soil. Some have thought that it could be grown and marketed at a profit.

The following table gives the amount used and value in the United States during a period of five years:

Fiscal year ending June 30—	Quantity (pounds).	Value.
1903	307,218	$9,210
1904	274,915	7,447
1905	301,513	22,959
1906	281,574	22,156
1907	651,595	51,128

Annato is used in the United States for coloring butter and cheese, and it is highly probable that the values given here are for the manufactured product.

The seeds are gathered and offered for sale in most of the markets in the Islands and are collected by the Chinese for export. They sell for about 4 cents per pound retail.

The following interesting extract is reprinted from the Bulletin of the Imperial Institute, Volume 11, No. 2, 1908:

Annatto is the orange-red colouring matter occurring as a layer of pulp on the outside of the seeds of the annatto plant, *Bixa orellana,* a small tree indigenous to South America, but now extensively cultivated in many tropical countries.

The supplies of annatto which reach the United Kingdom at present come principally in the form of seeds from the East and West Indies, and as paste from French Guiana or Brazil.

CULTIVATION OF THE PLANT.

The annatto plant grows luxuriantly in almost any soil, and in the Tropics will thrive up to about 3,000 feet above sea level. The soil is prepared for annatto in much the same way as for cotton. The seeds, previously softened by soaking in water, are planted in furrows at distances of 8 to 10 feet apart. As the young plants come up they should be provided with artificial shade to protect them from excessive heat, but later on a large amount of sunshine is necessary for their proper development. After three months the plantation should be weeded and superfluous plants removed. Beyond periodical weeding the plantation requires little attention.

HARVESTING.

Full crops of seed may be obtained in three or four years from the time of sowing, but the collection of seed may be commenced usually after the first eighteen months or even earlier. The fruit capsules are gathered when they have acquired a reddish colour and are just beginning to break open. This takes place from the pointed end along the edges and causes the seeds to be exposed. It is said to be advantageous to cut the branches along with the capsules, as in this way the plants are prevented from growing so high as to make collection a matter of difficulty, and they bear better.

The capsules are opened out on mats or cloths and allowed to dry completely in the sun, being turned over from time to time.

Three or four days' exposure is usually sufficient to accomplish this, and the fruits are then collected in heaps and beaten with clubs or threshed to separate the seeds. These are separated from the empty pods by winnowing or sifting, and again exposed to the sun until they are completely dry.

The seed is usually packed in barrels for export, but manufacturers using annatto in the United Kingdom recommend that they should be packed in double sacks holding from 1½ to 2 hundredweight each. Great care should be taken to see that the seeds are dry before they are packed, as if they are at all damp they are liable to become moldy and lose color.

COMMERCIAL VALUE OF ANNATTO SEEDS.

The prices obtained for annatto seed in London in the last few years have varied somewhat. Ceylon and Madras seed fetched from 6 pence to 7 pence per pound at the end of 1905, but gradually fell to 3½ pence or 4 pence during 1906. Jamaica seed similarly fell from 8 pence at the end of 1905 to 4 pence in October, 1906. At present 4 pence per pound may be taken as the average value. Java seed, which goes principally to Liverpool, is at present worth 4 pence to 5 pence per pound. The most recent quotations available are 4 pence per pound for Madras seed and 3½ pence per pound for Ceylon seed.

There is a fair demand for annatto seed in the United Kingdom and the annual imports are said to fluctuate between 75 and 100 tons, and manufacturers of annatto preparations are of opinion that the demand is likely to grow.

There is said also to be an increasing market in the United States for annatto, but this is likely to be met by a larger output from Jamaica. It should be borne in mind, however, that the annatto plant can be grown practically anywhere in the Tropics, and that plantations have been formed in many tropical countries, and that if prices rose there would probably be an immediate increase in output from plantations already in existence.

PREPARATION OF ANNATTO PASTE.

At one time considerable quantities of annatto paste were imported into the United Kingdom and other European countries from French Guiana and Brazil, but although text-books dealing with annatto dye still refer to the paste as the principal form in which annatto is imported, there is reason to believe that this trade has almost ceased. Thus no export figures for annatto paste from French Guiana have been given in the statistical returns for the French colonies since 1900. Annatto paste was imported into the United Kingdom from Ceylon in considerable quantities some years ago, but owing, it is said, to a falling off in the quality of the material, the demand for it diminished.

Manufacturers in the United Kingdom, and merchants handling annatto paste, say that the reason for the decline in the market for this article is entirely due

to the practice of adulterating it in the countries where it is produced, and that if a clean paste of good quality were produced it would command a ready sale. Unless, however, a paste of excellent quality can be made it is better to export the seeds.

In Brazil annatto paste was formerly made by crushing the seeds in hot water, decanting the liquid containing the colouring matter in suspension, and evaporating it to a pasty consistency in shallow pans over a fire. More recently, however, in Brazil and French Guiana the uncrushed seeds have been mixed with hot water and the mass agitated until the whole of the pulp carrying the colouring matter has been washed off. The muddy liquor so produced is decanted through a sieve to remove the seeds. The liquor is then allowed to stand until the insoluble colouring matter held in suspension settles to the bottom when the useless supernatant liquid is poured off and the wet paste or colouring matter is dried by exposure to sun heat. The paste so produced can be prepared for the market in several ways. It may be formed into rolls weighing from 4 to 5 pounds each, and, after drying, wrapped in banana leaves and then packed in boxes or sacks, as is the custom in Brazil; or it may be made into small cheese-like masses weighing from 1 to 2 ounces and these, when quite dry, packed in boxes holding from 4 to 5 hundredweight. The French Guiana variety of annatto is superior in quality to the Brazilian (Spanish).

It will be seen that no special machinery is required for the production of annatto paste by these processes, but doubtless the extraction of the coloring matter could be done more efficiently and rapidly if mechanical agitation were employed to keep the seeds in motion while they are in the water, and similarly the separation of the coloring matter from the mother liquor and its subsequent drying could be more cleanly and rapidly effected by the use of filter press.

Owing to the very small demand existing for annatto paste in the United Kingdom at the present time it is impossible to obtain a satisfactory idea of its commercial value, but it appears that Cayenne paste from French Guiana fetches about 10 pence per pound in France at present, and that good qualities of Ceylon paste when imported into the United Kingdom were worth, as a rule, from 1 shilling 6 pence to 2 shillings per pound.

USES OF ANNATTO.

At present annatto is principally employed as a colouring agent for food materials such as butter, margarin, and cheese. It was formerly used in considerable quantity for dyeing silk, but is now little employed for this purpose as better dyes less fugitive to light are available.

COCONUTS IN LAGUNA AND TAYABAS PROVINCES.

By A. F. Byars, *Agricultural Inspector, Bureau of Agriculture.*

In the rich Provinces of Laguna and Tayabas the coconut industry can be seen in every stage and from every aspect. The beautiful panoramic view to be obtained from Mount Banajao of the vast coconut regions as a whole, extending from the mountain to the lake in one direction and to the sea in another, is most impressive.

San Pablo, the largest and richest in agricultural products of all the towns in Laguna Province and the center of the coconut industry, is a town of about 25,000 inhabitants. It lies along the main road leading from Los Baños and Bay on the lake to Tiaong and Lucena in Tayabas, also on the main road from Santa Cruz to Magdalena, Lilio, and Nagcarlan, and on the other side through Alaminos on into Batangas. As a rule these roads are very good and facilitate trade. The ownership of the coconut groves, from which the town derives most of its wealth, is distributed among a comparatively large number of its inhabitants, so that while none of the people are very rich, none are very poor.

In this town a large part of the coconut crop is made into copra, which is sacked and sold in that form. Any day hundreds of pack horses loaded with copra may be seen coming from all directions into the town, where it is usually sold to dealers, who in turn load it on carabao carts (eight to ten sacks to a cart) and send it to Bay, where it is transferred to boats for Manila.

Coconuts are not harvested at stated seasons, but are gathered from each tree every two to four months. The nuts are detached by means of a hooked knife attached to a very long slender bamboo pole, or by a man who climbs the tree and cuts the fruit stalks with a sharp knife. The nuts are collected in piles and are sometimes husked before being removed from the groves. They are carried to the small factories by means of carts or sleds, or by pack horses in the hill country. Often they are floated down rivers and small streams in the form of rafts, but this is rather dangerous means of transportation, as was shown by a late *baguio* in Laguna which broke up numbers of rafts in Pagsanjan River, it being estimated by some that from 100,000 to 200,000 nuts were scattered over Laguna de Bay.

PLATE II.

MANUFACTURE OF COPRA.

The process of making copra in this section is very simple. It consists in husking and halving the nuts and drying, after which the meat is removed from the shells. They are husked by means of a pointed iron instrument, usually a plowpoint fixed on a three-legged stand. After it is hulled, a quick blow with a dull bolo halves the nut. For drying the copra, a small shelter is built over a rectangular hole from 1 to 2 meters wide, 1 meter deep, and as long as the shed, across which small poles are laid parallel, leaving a small space between each two. On these poles are piled the halved nuts, which are dried in about two days by the heat and smoke from the fire in the hole. Empty shells are used as fuel.

The dried meat, or copra, is then easily removed from the shells by means of a thin, chisel-shaped, curved knife projecting in front of a seat. After a little further drying the copra is ready for sacking and putting on the market. These small copra factories can be found scattered all about in the coconut groves of Laguna and Tayabas.

MANUFACTURE OF OIL.

During the past two months most of the coconut crop of Laguna has been marketed in the form of oil, especially in the hill country. Of course the small native factories are crude and a large per cent of the oil is left in the cake, but at the prices now being paid oil brings better returns than copra.

Where the oil is extracted in the grove there is no necessity for drying the meat; it is simply grated from the halves by a native machine with small rotary knives. This grated meat is put in open shallow iron pots and cooked. The resulting white mash is dipped into sacks and placed in a vertical press made of two large thick boards and a large wooden screw. The mash is often cooked twice and pressed several times, being milled or crushed beneath a weighted swinging roller before pressing. The white, milky mixture of oil, water, etc., which drips from the sacks is returned to the cooking pan and boiled until all the oil separates and rises to the top, when it is dipped off into five-gallon petroleum tins, and is then ready for market.

MANUFACTURE OF ALCOHOLIC BEVERAGES.

While copra and oil are the chief products of the coconut industry, a considerable number of the groves of Laguna and Tayabas are devoted to the making of tuba and alcoholic beverages. Distilleries can be found in the valleys or on the hillsides where water may be had to run through the commencing tanks by gravity. The Government has an internal-revenue employee stationed at each of these "alumbikis" as they are called, to collect revenue and see that they are run according to law.

Tuba is collected from the trees through the flower stalk. The many small branches are bound together, their tips cut off with a sharp knife,

and the end of the bunch inserted in a section of bamboo tube, which catches the juice. Early each morning a tuba gatherer climbs the tree, empties the tubes into a larger vessel, and cuts a little more off the ends of the flower stalks. Two strong bamboo poles bridge the distance between the tops of the trees and the tuba gatherer passes from one tree to another, walking on one pole and holding to the other. When the receptacle becomes full of tuba he lowers it to the ground with a rope and after it is emptied he pulls it up again. After the tuba is collected it is carried in three- or four-gallon vessels to the distillery on pack horses or by carriers.

BUD-ROT.

The purpose of the writer's visit to Laguna and Tayabas was the inspection of these provinces with a view to eradicating the bacterial disease known as "bud-rot of the coconut." The name bud-rot comes from its habit of attacking those portions of the tree which are in the tender or bud stage. The flowers are most liable to attack during the bursting of the flower sheath. Other tender portions of the apex are subject to attack at any period, but more particularly during the rainy season. The presence of the disease is indicated by the young leaves turning yellow and also by the dropping of the fruit. The decaying bud gives off a very offensive odor, by which the disease may be readily recognized.

METHODS OF TREATMENT.

After the disease has made sufficient progress to destroy or partially destroy the "cabbage," there is no hope of saving the tree. If the disease can be detected in an early stage of development, it can be checked by the use of fungicides, such as sulphate of copper, but the only practical means of combating it in these Islands is to cut the tree down and destroy it by fire as soon as the presence of the disease is detected. Owing to the fact that the disease spreads readily by the aid of the wind, insects, etc., it is well to destroy all portions of the tree by burning, if possible.

PREVALENCE OF THE DISEASE AND OUTLOOK.

The disease is found to be most prevalent around the base of Mount Banajao in the municipalities of Nagcarlan, Lilio, and San Pablo. More than 2,000 trees have been destroyed in one of the barrios of Nagcarlan. It is claimed by some of the inhabitants that the disease has existed in this town for the last ten years. It is probable that the moist atmosphere, due to the proximity of the mountain has contributed largely to its presence in this vicinity. A few cases have also been found in the towns of Pagsanjan, Santa Cruz, and Pilar. The damage done in these towns, however, has been small.

While all the trees showing symptoms of disease at the time of inspec-

tion were destroyed, it is quite probable that others have been infected by means of wind or insects carrying the bacteria and will develop the disease later. Presidents of municipalities, lieutenants of barrios (some in the most remote and out-of-the-way places), and the owners of the groves have been instructed as to the nature and manner of exterminating this disease and all should coöperate to keep it out. If reasonable measures are taken to suppress it, the disease will not prove serious.

INSECT ENEMIES.

The insect enemy which has up to the present time caused more loss to coconut owners in Laguna and Tayabas than all the other destructive agents combined is the "uang," or rhinoceros beetle (*Orycytes rhinocerus*). This insect attacks the most vital part of the tree, the bud, boring through and feeding on the young tender "cabbage." The coconut being endogenous, the destruction of this part means death to the tree. Thousands of trees are killed by this insect, but as yet no really practicable method has been discovered for destroying it.

Various methods are used, with greater or less success. The beetles may be extracted from their holes by means of a hooked wire. Pouring 5 to 10 cubic centimeters of carbon bisulphide into the holes and filling the opening with mud will kill them. Sharp-cornered sand sprinkled between the base of the leaves and the bud will make it very disagreeable for them to enter at this point. No thoroughly practical remedy has been found for the beetles when once in the tree, but their ravages can be largely reduced by cleaning the groves of all dead trees, undergrowth, and rubbish.

SOME FIGURES ON THE COCONUT INDUSTRY.

No doubt any information as to the cost of production will be of great value to the prospective investor in coconuts. The following figures have been computed from data collected by questioning dozens of coconut growers in Laguna and Tayabas Provinces:

	Cost per 1,000 nuts.
Cutting down from trees	₱1.00–₱1.20
Collecting in piles	.24
Husking	.60– 1.00
Halving	.20
Drying (copra)	2.50
Grinding meat (oil)	1.00
Present value per 1,000 nuts—	
As nuts	₱12.00–₱15.00
In oil	20.00
As copra	17.33
Average value of 1 hectare of coconuts	₱500–₱1,000
Average production of nuts per hectare	10,000– 12,000
Average yearly gross receipts per hectare	150– 200

It requires about 250 first-class, 300 second-class, and 350 third-class nuts to make 1 picul of first-class copra.

A laborer can cut down from 1,000 to 2,000 nuts a day, according to the height of the trees and the amount of underbrush in the grove. He can husk 2,000 or rasp the meat from about 1,000 nuts per day.

Cost of transportation of one cargo (four tins, or 20 gallons) of oil on a pack horse a distance of 20 miles (Nagcarlan to Santa Cruz) is about ₱2.50.

Cost of transportation of one cargo (2 sacks, 3,000 pounds) of copra a distance of 10 miles (San Pablo to Bay) is ₱1.50.

Owners of coconut groves make several kinds of contracts with their overseers for taking care of their groves and gathering and marketing the crop. A common one requires the overseer to do all the work of gathering, manufacturing, and marketing, standing all expenditures, and gives him half of the gross proceeds. Another calls for the owner to pay for the pulling down of the nuts and the transportation of the finished products to market, the overseer to do the rest and receive one-third of the gross proceeds.

In manufacturing oil, when the factory is not the property of the owner of the grove, the overseer usually pays for the use of it 25 centavos and one-half the oil cake per cargo of oil made.

The relative net profit to be derived from the production of oil and copra varies with the market prices of these two products. Sometimes oil, and at other times copra, is the more profitable of the two. Most natives prefer making oil so as to have the cake to feed to their hogs.

IMPORTANCE OF THE INDUSTRY.

After all is said and done concerning any industrial enterprise, agricultural or otherwise, the question arises, "Does it pay?" As regards the coconut industry in Laguna and Tayabas the answer is, Yes, it is already paying—it is the source of the wealth of these two provinces.

With the expansion of the coconut industry, continued planting of the young trees, and intelligent care of the groves, Laguna and Tayabas have indeed a bright agricultural future.

COCONUTS AND COCONUT PRODUCTS IN BRITISH GUIANA.[1]

The importance of planting permanent crops is not sufficiently appreciated by the average farmer. He is generally content to devote his whole attention to the growing of ground provisions, which will bring him in a quick return, but usually require replanting annually. The disadvantages of these are, first, that when mature they are generally of perishable nature, and the farmer is obliged to sell them at once however unfavorable may be the state of the market through overproduction or other causes. Secondly, a few crops soon exhaust the soil, especially as manure is often difficult to obtain in any quantity, so that in a few years the land becomes so poor that it requires to be thrown out of cultivation or rested for some years to bring it back into a state of fertility. It should be the endeavor of every self-respecting farmer to improve his land instead of impoverishing it, and to so plant it that he can leave it as a valuable property to his children.

The trees that might be planted to make land of some value are coconuts, cocoa, coffee, limes, and fruit trees. Lime trees and coffee, however, do not grow and bear to perfection, except in the lighter soils, and, like cocoa, they require to be sheltered from strong breezes. Most fruit trees will thrive on the ordinary stiff soils of the coast lands if they are given good drainage. Coconuts I propose to deal with in this paper.

I may state here, however, to avoid any misconception of my meaning, that I have no intention of advising you to give up growing ground provisions altogether or even to reduce the present production of these. My suggestion is either to plant a part of the land in permanent products or to put these amongst the ground provisions, which can usually be done with very little extra trouble and cost. The ground provisions will always be required for food, and there must be something of this kind to depend upon until your trees come into bearing.

The coast lands of the colony seem to be particularly adapted in many ways for growing coconuts, and most of the trees already planted give fair crops year after year although they are left in a state of the most utter neglect.

[1] (Published in *The Journal of the Board of Agriculture of British Guiana*, Vol. II, No. 1.)

Coconut palms will grow and bear successfully only within a certain distance from the seacoast; they delight in the strongest sea breezes and in the greatest amount of sunshine obtainable. They will not thrive when shaded by other trees or where the air is too still or where there is not a sufficient supply of water always available in the soil. The tree requires good drainage, and will not grow well with its roots in stagnant water.

SELECTION OF NUTS FOR PLANTING.

A careful selection of the nuts to be used in planting is of the very greatest importance, because it is very likely to make very much difference in the subsequent yield of the trees.

Seed nuts should be selected from healthy trees of strong and robust growth and of middle age which produce good crops of fair-sized nuts with thick kernels (copra.) Very big nuts are not by any means always the best, because sometimes it happens that only a few are borne on the tree at one time and often their large size is due to excessive thickness of the husk at the expense of the kernel. Oblong nuts should be avoided. A large orange-red variety known as the "claret" nut, is one of the best kinds in the colony for planting, because it produces large nuts with plenty of copra.

It does not necessarily follow that because a tree growing by itself produces large crops of nuts, these should be used for planting, because the yield may be due to the surrounding conditions. But if one or two trees growing amongst several others under similar conditions are found to produce larger numbers of nuts of the right kind than the rest, it would be well to obtain seed nuts from these for planting.

The nuts must not be picked until they are fully ripe; they should be gathered by hand and lowered from the tree and not thrown down as is usually done. To many it may seem a waste of time to follow these instructions for choosing nuts for sprouting when almost any ripe coconut will grow if planted in damp ground, but when it is remembered that a coconut palm may be expected to bear until it is at least fifty years old, it is easily seen that it is well to give plenty of attention to the selection of nuts at the beginning.

An increased yield at a moderate estimate of 10 per cent to 20 per cent for every tree each year makes a tremendous difference in the amount of the profits, especially if the total of these is calculated at the end of the fifty years.

In agriculture, perhaps more than in most other undertakings because the returns are seldom immediate, one requires to look a long way ahead. Mistakes made in the beginning are difficult or impossible to rectify later.

SPROUTING THE NUTS.

It is generally advisable to sprout the nuts first and to plant them out in the permanent places where they are to go when the young plants are large enough.

It is recommended to keep the nuts about a month before sowing, the effect of which is said to be that the husk loses some of its moisture and becomes waterproof.

A piece of good land is to be choosen for a nursery, either in or near the field where the coconuts are to be planted, and the soil is to be dug up to a depth of about 18 inches, so that the young roots which are put out can enter it easily. Trenches are then to be dug about 6 inches deep, and the nuts placed in them on their sides about 6 inches apart, either quite horizontally, or, better, with the pointed end directed slightly downward. The great mistake of planting the nuts vertically, as is frequently done was pointed out in Volume I, No. 1, page 11 of this journal.

Ashes should be placed in the trenches to keep away beetles and other insects, and the spaces between the nuts are then filled in with soil, so as to leave about a quarter of the upper part of the nut unburied. Over all should be laid about 6 inches of grass, straw, or cane trash. In dry weather the nuts should be watered every two days.

It is advisable to sow half as many nuts again as the number required because a certain number of them will not germinate, and some will produce bad or weakly plants which it will not be desirable to plant out in one's own cultivation.

The nuts are ready to plant out when the shoots have reached a height of about 18 inches, which will take from six to eight months' time.

PLANTING OUT.

On good land the trees should never be planted closer than 2½ to 3 roods apart. (The Rhynland rood is equal to 12 feet 4 inches, a standard measure of length for land in British Guiana.) The spreading roots of the full-grown trees will occupy all the intervening space at this distance apart, and if planted closer the leaves will cross and interfere with each other. In poorer sandy soils only is it safe to plant closer, but not less than two roods apart.

Holes for planting are to be dug about 3 feet wide and 2 feet deep. The soil taken out of the holes is to be thoroughly mixed with some well-rotted manure or leaf-mould and then put back again into the holes and allowed to settle for a few weeks before the plant is put in.

When removing the sprouted nuts from the nursery every care must be taken not to injure the roots, and any that may be broken or injured should be cut off close with a sharp knife before planting. A smaller

hole is made in the middle of the prepared hole large enough to contain the sprouted nut with its roots, which is placed carefully in the hole and the soil filled in around it so as just to cover the nut. Many planters cut off the ends of all the roots that have formed from the sprouted nuts, as the growth of new ones is supposed to be hastened by doing this.

The writer is of the opinion that it is a mistake to bury the nuts deeply in the soil as is advocated in some agricultural works, mostly with reference to lighter soils, because this practice, if followed here, appears to have a retarding effect on the growth of the young palms in our heavier clay soils. One advantage that deep planting is said to possess is that it enables the plant to secure a firm hold of the ground and prevents it from being overturned by a strong wind; but I have heard of no such instance of a coconut palm being blown over in this colony.

The manner of planting followed in Ceylon, where, as a rule, the most scientific methods of agriculture are adopted, is to remove the sprouted nuts when they are about six months old from the first nursery to another one where they are planted 3 feet apart and high cultivation is bestowed upon them. They are not transplanted into the positions they will permanently occupy in the cultivation until they are from two and a half to three years of age. All nuts which are slow in sprouting in the first nursery are rejected and not replanted into the second one, and any plants in the second nursery which do not show vigorous growth are also rejected. This method gives opportunity for a very careful selection of only the best plants, and it is claimed that fields planted in this way are most regular and yield the largest number of nuts per acre.

The saving effected by not having to keep the whole field clean for the three years during which the nuts are growing in the nurseries is claimed to more than cover the cost of the nurseries and transplanting the three-year-old plants.

CARE AFTER PLANTING.

In this colony, with very few exceptions, after a nut either sprouted or unsprouted is put into the ground the farmer considers that he has done everything that can be expected of him until the tree comes into bearing, when he will gather the nuts as they become ripe.

This total neglect of everything that can be called cultivation is probably one of the principal causes why there is so much disease at present amongst the coconut palms in the colony.

After planting, the ground for a short distance around each tree should be kept clean by periodical weedings. A careful watch must be kept for the attacks of the large coconut beetle or "cockle" which is sometimes very destructive to young palms. Putting ashes around the plants is

said to keep cockles away or a layer of sand has been suggested as a preventive of their attacks. In any case, it is important that the young palms should be examined at frequent and regular intervals. When one of the large tunnels made by the beetle in the soil, usually close to the stem of the young plant is observed, the insect must be sought for by digging and destroyed, or it will kill the plant by eating its way up into the center.

Young coconut palms require plenty of water, and in very dry weather this must be given to them. The Hindoos have a pretty saying referring to young coconut palms, which runs: "Water me continually during my youth, and I will quench thy thirst abundantly during the whole course of my life."

All of the weeds obtained by weeding around the trees as well as any other grass and brush that can be obtained should be put around the trees to form a mulch, both to preserve the moisture in the soil and when they decay to furnish food for the plant. These must not be piled up close round the stem but spread out so as to form a layer for some distance around the tree. Applications of manure and wood ashes are also good for the plant.

Care must be taken that the nuts are kept covered with earth because if not deeply planted they are often apt to grow out of the soil in time. When this happens earth should be put around the base of the palm, so as to again cover the roots. Any catch crops such as cassava, sweet potatoes, maize, tannias, etc., may be planted between the trees but not so close to them as to interfere with the roots and check the growth of the young palms. When the trees reach a fair size, I should imagine that their root system is sufficiently strong for the plants to be able to look after themselves in this respect and that other plants growing too close to them would suffer more than the palms themselves.

It is well known that coconut palms here as well as in the islands are sometimes attacked and killed by certain fungous diseases. A short account of the most important of these, based on a report by the Mycologist of the Imperial Department of Agriculture, was given in Volume I, No. 1, of this journal, and remedies were recommended for getting rid of the diseases. Prevention is better than cure; and the most important preventive is to endeavor to maintain the trees in a thoroughly healthy condition by attention to drainage, etc. Nuts for planting must be taken only from the most healthy and vigorous growing trees and any weakly plants should not be planted.

In the case of palms killed by some disease it is of the greatest importance to destroy any parts of the dead palm infected with the disease, in order to prevent it from spreading to other palms. Instructions for this are given in the article already referred to.

Coconuts will sometimes begin to bear nuts in small numbers when

they are about six years old, but they usually take a few years longer to come into full bearing. They will continue to produce nuts until they are from sixty to eighty years of age.

From inquiries that were made some time back from various coconut planters in the colony, the average number of nuts that may be expected is from eighty to one hundred per tree per annum. Individual trees were mentioned as giving from one hundred and fifty to two hundred nuts each year.

There is little doubt, considering how favorable the coast lands appear to be for the growth of the coconut palm, that with careful selection of seed nuts and attention to planting and cultivation, the average yield might be considerably increased, probably by half as much again.

Most of the large areas in the colony planted in coconuts receive no attention, beyond picking all the nuts that can be obtained, and are practically left in an abandoned condition. Therefore, the yields reported from them furnish little or no guide as to what should be the returns.

COCONUT PRODUCTS.

The chief value of coconuts is in the oil that they contain. Either the nuts themselves may be exported, or copra, or coconut oil. At the present time there is a great demand for coconut oil and copra, and the nuts are also obtaining a good price.

Coconut oil obtains a higher price than any of the other oils of its class, being especially suited for soap and candle-making. The soap manufactured from it is firm and white, and has the property of readily forming a lather with sea water, which renders it especially valuable for use on board ship.

Preparations of purified coconut oil are employed for edible purposes in England under the names of "vegetable butter," nucoline, etc.

Coconut oil is generally stated to have a great tendency to become rancid, but it has been proved that this deterioration is brought about largely by the moisture and other impurities contained in the impure oil. Pure coconut oil will keep as well, if not better, than most other vegetable fats and oils.

In the manufacture of oil one very important fact is too frequently overlooked, viz, the nuts must not be used until they are fully ripe. Experiments, for instance, have shown that the percentage of oil in a fully grown, but still green, nut is only about half of that contained when the nut is fully ripe. The percentage of oil goes on increasing in nuts which are stored for three months after they are ripe, so that a considerable loss of oil is incurred in obtaining oil from nuts freshly gathered from the trees or picked before they are ripe.

The shipment also of immature nuts depreciates their value in the markets, and the planters in Trinidad think that the only way to avoid

PLATE III.

the pickers gathering some unripe nuts with the ripe ones, is to allow the trees to drop their nuts in the natural course. It has already been pointed out that fallen nuts should not be used for seed purposes.

MANUFACTURE OF COPRA.

Copra is the commercial name for the dried kernel of the coconut, from which oil is extracted, and which forms one of the principal articles of export from the islands of the South Pacific.

The necessity of using only fully ripe nuts which have been kept for some weeks after gathering is as important in the preparation of copra as in the manufacture of coconut oil. Copra made from unripe nuts contains a smaller percentage of oil, takes longer to dry, and turns moldy more readily.

When storing nuts to make copra or oil it is, of course, essential to keep them under a shed, where they will be protected from the rain to prevent them from beginning to germinate.

The first operation is husking the nuts. This is performed by striking them on the sharp end of an iron bar strongly driven into the ground. One man can husk on an average of about 1,000 nuts in a day. A new method of removing the husks was mentioned and illustrated by a photograph in the Proceedings of the Agricultural Society of Trinidad and Tobago for April last. The sharpened corner of a mattock or heavy hoe is firmly fixed into a wooden framework, and is said to split the husk much more readily than the pointed iron stake.

The following simple methods of drying copra are employed in the Philippine Islands. The nuts are split in half by two blows from a cutlas, and the two halves are dried by spreading them in the sun face upward upon large wooden trays, which can be moved at nighttime and in case of rain, under a shed. Two or three days in the sun are sufficient for the meat to become partially dry and sufficiently shrunken to be easily removed from the shell. They are then put back in the trays and exposed for a few days longer to the sun until thoroughly dry.

Another method in use is to pile the halved coconuts face downward on a bamboo grating over a slow fire of husks burning in a brick kiln about 6 feet high, the whole inclosed in a large shed. One night's drying is sufficient to remove the shells, and after heating in the same manner for four or five hours on the next day, the copra is ready to store for the market. Grill-dried copra is less liable to mold and to the attacks of insects, but is considered on account of its dark color and smoky flavor, to be inferior in quality to the sun-dried article.

For drying copra on a large scale, an arrangement similar to that of an ordinary cocoa-drying house is used, and the only manipulation required is to frequently stir and turn over the pieces of copra, so that all parts may be exposed to the drying action of the sun and wind. The length

of time required to dry the copra thoroughly, varies from five to ten days, according to the amount of sunshine and atmospheric conditions.

Artificial heat is sometimes a necessity, and in the construction of a house for this purpose, it must be remembered that heat is of only secondary importance, and that ventilation or the means of circulating dry air, and the removing of moist air should take the first place. The use of heat is not to directly heat the copra, but to dry the air, and enable it to take up more moisture than it otherwise would in its passage through the copra. An artificial dryer can be run very economically, all the fuel required being furnished by the husks and shell of the nuts.

With regard to the yield of copra, this depends very much upon the size of the nuts, and the figures quoted for the produce from 1,000 nuts vary so greatly in different countries that it is of little use mentioning them. The most profitable plan appears to be using the small nuts for making copra and selling the large ones.

The advantages of copra are, as just stated, that nuts of inferior size if fully ripe, can be used for its manufacture, which, if exported whole, would obtain a poor price; also, we have a product which will keep for some time, should the state of the market be unfavorable. In addition, the cost of exporting copra, is of course less than that of shipping the nuts.

It is very desirable, that a plant of any kind for manufacturing copra, should be situated either on or in the neighborhood of the cultivation where the coconuts are grown to avoid the cost of transporting these.

COCONUT OIL.

At present the bulk of the coconut oil produced in the colony, which is largely used by East Indians, is made by small producers. There is, I believe, but one plantation furnished with a proper crushing mill for reducing the copra to a fine state of division and an hydraulic press for squeezing out the oil. The small grower employs a rotary grater for grinding the copra, the pieces of which are held against the grater by hand, and after a preliminary boiling, a hand-press is used for removing the oil remaining in the meal. It is unnecessary to add that the oil so produced generally has poor keeping qualities, and inferior extraction is obtained, and the cost of production is high.

In Trinidad, where several of the large coconut estates are equipped with proper appliances, including an hydraulic press, they have been able to pay more for the nuts of the small growers than the latter could realize by turning them into oil by the old crude method.

In an article on "Coconut oil" by Mr. W. Greig, in "Industrial Trinidad," the writer states that "the cost per gallon of oil extracted does not exceed 10 cents in a small plant capable of an output of 100 gallons per day, including capital and depreciation charges, as well as labor and supplies."

It must not be forgotten that the residual meal left after the oil has been extracted, forms a first-class food material for cattle, swine, sheep, and poultry, and will also serve as a partial substitute for oats with working horses. In most plantation oil factories, the value of the residual meal as a stock food covers the cost of manufacture. Probably the most profitable way to employ it would be to use it for feeding stock on the plantation and spread the manure from the animals around the roots of the trees.

With regard to the comparative profits to be obtained from the shipment of coconuts, copra, or oil, this will depend on the price for which each is selling at the time. It is recommended that each plantation should have a simple table calculated from its cost of production and results showing the relative values of nuts, copras, and oil to serve as a guide in the disposal of its products.

PROPAGATION OF TOBACCO IN CUBA.

By C. F. Baker.

SEED.

SEED SELECTION.

Good seed is one of the most important items in tobacco culture. It is perfectly true that poor seed—seed taken from secondary sprouts on all kinds of plants, good, bad, and indifferent, seed cut before it is ripe, and large and small seed together—may all be planted, and then, with sufficient outlay in fertilizers, water, and care, fairly good tobacco may yet be made. But it is not a good business proposition when, if the best seed and rightly grown posturas are used, as good and far better tobacco may be grown at less cost. It has been proven conclusively elsewhere, and also in Cuba, that seed selection pays; seed from plants of the finest type only, seed from the main terminal flower cluster, seed from the largest strongest capsules, and finally the heaviest seed. We tested this in a way, in our experiment plots, by making a planting on very poor ground, ground that had been occupied only by Johnson grass, using very strong and healthy posturas from heavy seed that had come out of the best parents. The ground was very carefully and thoroughly worked, but received no fertilizer of any description and had only a very uncertain water supply. Cultivation was frequent and careful. The resulting plants were as tall and strong and produced as many leaves and of as good quality as any uncovered tobacco in near-by vegas which had received fertilizers in quantity and water ad libitum. This does not mean that good tobacco may always be raised on worn-out soils without fertilizer, by use of good seed and posturas, but it does mean, and that most emphatically, that these two items are of the very greatest importance in tobacco culture.

Most plants require the union of two sexual elements to produce seed, very much after the manner of animals, and with very similar results so far as heredity goes. The fine yellow dust called pollen we may speak of as the male element, and the pistil which stands in the center of the flower, and the lower part of which eventually develops into a capsule, as the female portion. Hence both sexes may occur in the same flower. Commonly through the agency of insects the pollen is carried

from flower to flower, causing broadcast mixture of blood within each species, and with most plants it is a decided advantage to the race to have the mixture take place. Besides it actively promotes continuous variation. So that in the case of tobacco it will not do to simply mark plants in the field and afterwards collect the seed from these. Fortunately tobacco happens to be a plant that readily submits to inbreeding—i. e., forms good seed by the use of the pollen in the same flower. The progeny resulting from this inbreeding possesses the very desirable quality of remarkable similarity to the parent, so that seed so produced from selected plants possesses a far higher value than ordinary seed. To insure inbreeding a stout paper sack must be placed over the entire flower cluster before any of the flowers are open, and tied in so closely to the stem below that no insects may enter. Large sacks, at least 18 inches long, must be used, and they should be examined at least twice each week and moved up to keep pace with the expanding flower cluster. Heavy winds will whip these about and break off the plants if long sharpened sticks are not run down close to the stems and the sacks tied to them at top and bottom. This selecting should all be done in the open fields instead of under cheese cloth, the planter personally going through and distinctly marking just such plants as he considers of the best type and quality and to him altogether desirable, *before* the first topping is done. These selected plants should not be topped, but be allowed to develop normally until time to put on the bags. Later on no harm will be done if some of the best leaves on these plants are picked, but the majority of the leaves should be left undisturbed. As soon as the flowers have all dropped, the bags may be removed and stored in a dry place for another year's use. The capsules should be allowed to remain on the plant until perfectly ripened. After the bags are removed, a boy with a pair of old scissors may be sent through to cut out all the small and weakened capsules. Plants vary widely under different conditions and even under the same conditions in the amount of seed produced. From ten plants which we had selected, which had set a fair number of capsules and from which all the small capsules had been discarded, we obtained 100 grams of fine clean heavy seed. But many weights should be taken under varying conditions to get at a safe average that could be used for general estimates. However, using the above figures, it would require the bagging of at least forty-five good plants to secure a pound of the best heavy seed.

Ordinarily in Cuban seed beds immensely greater quantities of seed are used than there is any necessity for. *Good seed should never be thickly planted* in the permanent seed bed, *and poor seed should never be used at all.* One gram should be plenty for each square yard of seed bed. This would be about an even teaspoonful. To insure even distribution the seed should be thoroughly mixed with many times the amount of finely pulverized soil taken from the same bed when it is ready to

plant. At the rate above mentioned there will be required about 10 pounds of seed to the acre of seed bed. When it is considered that good Cuban seed often runs 5,000,000 to the pound, it will be recognized that a good margin for losses and nongermination is still left. Scarcely any Cuban seed as now placed upon the markets can be properly measured except after careful cleaning and separating of the heaviest seed. By careful winnowing we have found that in many samples of Cuban seed the chaff and dirt run as high as 10 per cent.

We have made many germination tests of samples of Cuban seed. If seeds are cleaned and the heaviest carefully separated we have found that they will then give a 60 per cent and higher germination test. The lighter and smaller seeds from these same samples gave germination tests usually lower than 30 per cent and very rarely higher. The smaller and lighter seed produces poorer plants and in the seed beds even the 30 per cent that might sprout would only interfere with the better posturas and would probably largely go to make up the usual percentage that is discarded from every seed bed as too weak and spindling to be usable. Experts in the United States Department of Agriculture have devised a machine for cleaning tobacco seed and separating it according to weight, and this machine is manufactured by Messrs Queen & Co., of Philadelphia. The thinner planting that good seed makes possible not only produces better posturas but hinders the spread of the fungus which thrives best and spreads most rapidly where plants are crowded.

VARIETIES.

The name "Cuban tobacco" is to-day an almost meaningless term. One may go into almost any vega and find there a mixture of many types, some of then representing wholly distinct varieties, ranging all the way from the "lengua de vaca" form to a very broad-leaved and very desirable type. After the ten year's war, seed of Mexican and States tobacco that was more or less like the original Cuban, was introduced here in large quantities to supply the then almost universal demand. Later a law was passed calling for the destruction of all these foreign tobaccos. Such a law was, however, utterly futile, since the blood of these tobaccos was already spread broadcast and the seed distributed entirely beyond hope of complete extermination. These tobaccos are lusty growers and coarser than the genuine old-time Cuban. Their fruit is larger and more copious, and possibly was, for this reason, at first more commonly gathered by vegueros. The result has naturally been that the Mexican tobaccos (*Nicotiana tabacum* variety *macrophyllum*) are to-day predominant in a large part of Cuban vegas. At the Estación and in neighboring vegas it is the sole type, *none of the original pure Cuban tobacco* (*Nicotiana tabacum* variety *havanensis*) being present. These forms were long ago (some as early as 1818) characterized in exact bota-

nical terms so that they can now be recognized with certainty by the technical expert. Ordinary commercial Cuban seed of to-day is largely, and often altogether, Mexican tobacco. We will admit readily enough that it greatly improves any variety of tobacco to bring it here and grow it under the soil and climatic conditions of Cuba—improves its aroma and texture, and makes a more valuable product of it—but we will not for a moment admit that it transmutes the variety into something else. If small lots of foreign varieties were openly planted and allowed to flower in Cuban vegas they would eventually be crossed and recrossed until they were completely blended with the common Cuban forms. But after the ten years' war was over, the introduced tobaccos were the predominant ones, and the original Cuban tobacco was the one to be swamped under the stronger characters of the other. For tobaccos with exactly the characters of the introduced types are now the dominant forms. Suppose that most of the native razorback hogs of Cuba were exterminated and great numbers of improved red hogs were introduced. It would mean the complete disappearance of the original form of native hog, and not all the effects of climate and food could transmute the red hog into the former type of Cuban razorback.

There is little question but that in the more remote and isolated vegas of Pinar del Río, where the posturas have always been as a rule home-grown, there will yet be found the original and genuine Cuban tobacco, true to the original type. It only remains for careful search to be made during the flowering and fruiting season of tobacco, along the foothills and through the mountain districts. Once found, the more desirable forms could be restored in all the vegas where it was desired, in one to two seasons. The work only requires proper facilities for getting about over the country and then freedom of action; with these a very great deal could be accomplished in a very short time in the much needed work of selection and improvement of existing Cuban tobaccos.

Through constant inquiries about the suitability of still other varieties of tobacco for Cuban vegas, we became interested in their possible introduction, hoping to find some that under Cuban conditions might be an improvement over the common form now grown, or that would introduce tobaccos of aromas that could be used to produce improved or new and novel blends. To this end we introduced a considerable number of varieties from other countries and planted plots of selected seed and selected posturas of each variety.[1] There was absolutely no danger of any mixtures occurring in this work, because it was all done under close control, and all flowers were carefully inclosed in sacks. Naturally many of these varieties like little dutch, white stem, Virginia, Orínoco,

[1] **We acknowledge many favors in this connection from Mr. A. D. Shamel, Tobacco Expert of the United States Department of Agriculture.**

Tennessee Orinoco, and white burley, proved absolutely valueless so far as the Cuban tobacco business is concerned. There are some however, which are hybrids based on Cuban tobaccos, like Brewer's hybrid, Cooley's hybrid, Connecticut Havana, improved Connecticut broadleaf and Zimmer Spanish, which, using seed from selections made by experts in the States, gave, under Cuban conditions, magnificent types of tobacco that certainly demand the attention of Cuban growers. Tobacco men who saw these at the Estación, expressed the deepest interest in them and a desire to see them grown under cheese cloth on a commercial scale. It can very safely be said that their introduction will not injure in any way the common tobacco now grown in Cuban vegas, though an admixture of their blood might easily bring about an improvement. Besides, under current methods of topping and suckering, if it be thoroughly done, crops of any of these could be grown here any where with no mixture whatever resulting.

SEED BEDS.

Tobacco seed beds in Cuba under present methods of management, certainly can not be called an economic success. They are commonly planted on newly cleared ground along hillsides, it first being burned over and then the seed scratched in, and the plants kept weeded as much as possible until ready for pulling. These beds are quite commonly remote from water. This is a blind trusting in Providence, not worthy of modern conditions and methods and not productive of any sure results. It is true that during some favorable seasons good crops of posturas are obtained, occasional showers coming just right to bring things along nicely, without enough dampness to stimulate the fungus, and without heavy storms to wash out the young plants. But this is an utter dependence on chance. Often there are tremendous losses from damping-off fungus, insects, excessive rains, or drought. Last year one company lost 200 out of 300 acres of seed beds, and was compelled to buy posturas after all the expense of working the seed beds. The certain obtaining of good seedlings when and where they are needed is one of the most serious problems facing the grower. We have proven conclusively through three consecutive years of practical seed-bed management in Cuba, under all sorts of conditions, that there is absolutely no need of the larger part of these losses, and we have devised means and methods of avoiding them. We have also shown by repeated successful trials that it is readily possible to produce seedlings regardless of time and place, and largely independent of existing conditions of weather. There is nothing secret about the process, nor does it depend upon any specific or manufactured compound or patented article, but it depends absolutely upon sane and intelligent management.

The time will surely come in Cuba when all the planters will recognize

that the only proper place for a seed bed is beside the vega. By cheap and very simple means water and light can be absolutely controlled. Couple this with proper methods of constructing the beds and planting, and difficulties with seed beds will be a thing of the past. Under the old methods commonly in vogue the planter is at the mercy of fungus, insects, storms and weather. Our experts have exerted themselves to discover palliatives for some of the troubles encountered. But it is infinitely better to *avoid* the troubles even if we may know a possible remedy for them after they are making inroads on our plantings. Prevention is certainly better than cure, always. In our improved practice there will be no need of any treatments for fungus because there will be no fungus to treat, and the possibility of insect injury will be reduced to a minimum, and all this at no greater expense than is involved in the cumbersome older methods. There is no necessity for any very radical changes, but only a few modifications of detail. There must be a soil as good as that of the mountain seed beds, a bed that a stream of water coming from any ordinary rain can not wash away, and a cover that will shut out water completely if desired, cut off a part of the light in midday, and at the same time be readily handled. All this we have supplied in the methods that we have used. Some planters have covered their beds with cheese cloth, but this is no protection from the heavier rains, which may readily destroy their entire planting. Others have used canvas, but canvas is too heavy and thick and its cost is prohibitive. We have used the waterproof so called "horticultural cloth," the preparation of which is described below, and this suits the purpose perfectly.

PREPARATION OF BEDS.

Preparation for the seed beds of the coming year should certainly begin just as soon as the last year's crop is out of the way and the planter is free to give his attention to other things. Good seed beds need a very large quantity of the best and most perfectly rotted manure, and it is almost never possible to obtain this at the last moment. It must be secured very early and afterwards properly handled to get it into the right shape for seed-bed work. It must be so exceedingly well rotted that it can be mixed into the seed bed with mattocks and produce a very fine soft and friable loam. Undecayed portions and bits of straw and sticks greatly increase the possibility and rapidity of fungus attack. Too great care can not be given to the preparation and proper mixing of the seed bed soil. And it can not be emphasized too strongly that enough compost must be used to completely modify the character of the soil in order that it shall be most suitable for good seed beds. In the permanent seed beds which should be built in every vega the cost will of course be far greater for this first year than it will be for any succeeding year.

There is a good deal in picking out the right location for seed beds. It should be a spot protected by trees or shrubbery or buildings from prevalent winds, and a spot with very free surface drainage. When properly built and well-prepared seed beds are once established, their maintenance will involve far less expense than the preparation of new seed beds in the mountains or elsewhere. Initial expense will be somewhat greater in the former case, but results amply justify it. Besides in the case of the mountain and other seed beds more or less loss is always probable, and this has led to the preparation of far greater areas than there is any need for. The losses certain to come to any planter putting his faith in the old style seed beds will cover many times over the cost of preparation of the new, whereas the results of the latter have a very high degree of certainty.

The extra expense of the new seed beds lies chiefly in the preparation of covers and this work should be concluded before the end of July. The cost of material of the light framework over which to spread the covers is very small. The upright posts may be cut in any manigua, or even all the necessary material. If other material be not available we have found that ordinary drying poles split by ripsaw serve the purpose admirably.

If beds are made where there is no danger from surface wash, there is no need of banking them at the side with poles or old boards. They should however, in any case be built up to at least 6 inches above the surrounding ground. A planter in this immediate vicinity who built beds last year in a place subject in heavy rains to a rapidly running wash of 2 to 4 inches, did not think it "practicable" to go to the expense of banking or properly ditching them, and as a result lost his entire plantings in the first heavy rain, and was compelled to buy posturas after having borne the expense of preparing the seed beds. Cheap and careless methods will never give reasonably safe results that can be depended upon in any business. We would recommend that the beds be made not more than 3 feet wide or better a little less, and not more than 10 feet long. This width and length makes them convenient in many operations such as building, weeding, managing covers and so on, and has commended itself to us for use in all vegas of ordinary size. The production of posturas as a business by itself is another matter. Professor Earle has shown that beds constructed on exactly this same plan can be just as easily built and operated to a size of 12 feet wide and 50 feet in length. In these large seed beds the framework for the cover is highest in the center and the covers roll up in one continuous sheet on either side.

The covers are best made of so-called "factory cloth," 2 yards wide. This cloth is a cheap, coarse, but close-woven and stout muslin, and should not cost more than 6 to 8 cents per yard. If this is dipped in

boiled linseed oil, the excess wrung out, and then hung over lines, fences, or bushes, until dry, afterwards with brushes given another coat of the same oil on either side and again dried out, it makes a durable waterproof cover that may be used for a number of years if handled with ordinary care. Each year a new coat of oil will completely restore them. A very little turpentine added to the oil will increase the rapidity of drying. The pieces should be cut 2 feet longer than the length of the beds so that they may hang down at either end. Each long edge should be tightly nailed between two strips which hold them securely to prevent tearing, on which they can be rolled, and which stretch them tightly when they are unrolled. These cover strips should be as long as the bed, the one on the back or higher side of the bed can be attached to the framework by cords, and the front strips should also be provided with stout cords so that they may be quickly lashed tight in the case of cyclonic storms or high winds. During early mornings and late in the afternoon, two boys can very rapidly roll these covers to the top and fasten them, or loosen them and roll them down during midday or in storms. As soon as the posturas are large enough and ready to harden off for planting, the beds should be left open longer each day until the covers may be removed, rolled up and stored in a dry place across rafters until the next year.

PLANTING.

The beds being ready and the frameworks up, planting may be done at any time, and the untiring care in connection with watering and managing the covers begun. By this time the soil will have been properly prepared, and if the beds be banked by boards or poles, the soil should fill it to the very brim, and should be carefully fined and leveled off with a rake. Every bed in which it is intended to raise posturas directly from seed without intermediate handling *should be carefully and thoroughly sterilized.* This operation is essential to the best success. Just so surely as prevention is better than cure, just so surely is it better to do this work thoroughly and not be compelled to suffer losses and work with remedies afterwards. Formalin has been recommended but is so costly as to be practically prohibitive, to say nothing of the fact that its action is uncertain, and that when put on strong enough to effect a perfect sterilization, it will, under certain conditions interfere with the subsequent growth of the plants. In ordinary strength it does not sterilize. The method almost universally in use in Cuba is firing. In the case of fire built on the surface of the ground the heat seems to largely go upward, whereas the penetration downward in the ordinary procedure is very slight, only the most superficial layers being sterilized. We prepared a number of small beds and in conjunction with the department of vegetable pathology, treated them by these methods, and also by a third method in common use in other parts of the world—hot water. Water

was heated to near boiling and thrown over the beds. In all these test beds seeds were planted very thickly to give the best possible condition for the action of the fungus. Otherwise the beds were treated exactly the same. The hot water beds were perfectly clean for many days. Finally two or three small spots appeared in two of the beds, the source of infection probably being below the surface or outside the bed. The water was thrown on with a pail and hence the application was not as uniform or effective as if put on with a pot. One of these beds remained perfectly clear of the fungus. In the fired and formalin treated beds the plants were eventually all swept away. Later another bed was treated with hot water, it being put on boiling hot with watering pots and every inch of the surface gone over twice and given a through wetting. The crop in this bed was perfectly clear of fungus. If the water is put on first, the planting should be deferred for several days until the soil becomes quite friable again.

Remembering the now universally used Jensen hot-water treatment for smut in certain grains, in which the grain is immersed in water at 55°, we tried the experiment of planting seed and putting on the hot water afterwards. In one bed the hot water was put on at 55°, but a half inch below the surface this became only 48°, and while this bed showed up very well still some fungous spots finally appeared in it. In another the water was put on at 62° and caused a temperature of 58° a half inch below the surface. This bed was perfectly clear of fungus throughout, and the seed came up more quickly than in any of the other beds. However, this increases the complexity of the operation, and would require constant testing with a thermometer in the hands of a competent foreman, whereas if applied before planting the only direction is to go over it twice thoroughly with water *boiling hot,* and any farm hand can do this. We do not believe that this method would be much if any more expensive than a thorough firing and it would certainly be far more effective. If a dozen large kettles could be had, putting two men to each four kettles, refilling as fast as used, moving, and keeping fires going, a great many acres of ground could be gone over in a very few days. No remixing of the soil should be done after sterilization.

If the soil of the seed beds is carefully worked and mixed several times between spring and planting time and then sterilized with hot water which penetrates deeply, there will be no loss from fungus and probably none from cut worms. We found also that the attacks of flea beetles decreased in proportion to the increase in the height of beds, beds at ground level suffering most severely. Also beds that are kept carefully covered during the day while the plants are very young do not suffer from flea beetles when beds alongside uncovered or only partially covered will suffer severely. If, however, after all possible preventive precautions are taken, there is still some damage by insects or fungus the Bordeaux

mixture recommended by Mr. Horne should be promptly sprayed on the affected portions.

It is perhaps needless to say that the beds should be kept perfectly free from weeds. All the time weeding is done, the plants should also be freely thinned where they come up too thick, the smaller and weaker plants being the ones removed. This will give a more even stand and besides will be a not inconsiderable deterrent to the action of the fungus. It also contributes very materially to the production of stronger posturas.

TRANSPLANTING.

Appreciating fully the enormous difficulties and expense in any proper sterilization and care of extensive seed beds, we have constantly sought methods whereby the work and expense involved could be reduced and the results at the same time made still more certain. At the same time we have labored to reduce the time involved in the production of usable posturas from seed. We have in successful operation now a method that makes entirely unnecessary the sterilization of any except a very few of the beds, that insures the very finest quality of posturas with a certainty wholly unknown in older methods, and that this year on the Estación grounds made posturas ready to plant in thirty to thirty-five days from the seed. Under this method planting out could begin thirty days from seed with almost absolute security, and proceed without intermission thereafter. In native Cuban seed beds the posturas are pulled up, the dirt shaken off from such roots as still remain on the plant, and tied in the bundles for transportation to the vega—sometimes a journey of several days. But among the almost always overcrowded plants many are too small to use and these are left for later pullings. The quality of these later pullings is always considered far below that of the first. By our method there are no later pullings, all of the posturas being of the best possible quality, and most uniform possible growth. * * *

The rather remarkable immunity to fungus attack possessed by the healthy transplanted plantlets is quite surprising. We made a very interesting and important test in this connection by transplanting large series of small plants into beds that had just been swept clean of the first direct planting by fungus. The lots transplanted into such soil suffered no loss and thrived from the beginning.

These methods are not original at all with us. They have been found the safest and best methods in other parts of the world and are commonly followed also in the propagation of tomatoes, eggplants, peppers, and cabbages in the United States, where many thousands of acres are planted to these crops. All of the seed beds in our propagation garden for the past three years have been handled by these methods and we have been constantly astonished at the ease with which they can be carried out and with the far greater certainty and the far better quality of the results

obtained. Some planters have not been ready to indorse these methods, regarding them as impracticable. But these are usually men not acquainted with the practical working of the methods and so not competent judges. Careful estimates on this year's work show that the extra handling can be done at a cost not to exceed 15 to 20 cents per thousand posturas. The gains are finer posturas, quicker production, avoidance of fungus and necessity to sterilize, and far more certain results, points which we regard as alone amply justifying the method and making it entirely practicable on any scale. We believe that these points will commend the method to a thorough trial by the most intelligent Cuban planters.

The work is all done, and the preparations made exactly the same up to the point of planting. Then for each ten or more beds it will only be necessary to sterilize and plant one, but this one should be planted much more thickly than ordinary. As soon as the plants are up and large enough to be handled by fingers, boys should be used for the work of transplanting. They should straddle the bed, seated on a piece of board which crosses the bed, and set the plants well down in the ground firming the earth around each one with a single movement as rapidly as they can be handled, and in straight rows across the bed, hitching the seat board back as they go. This work should be immediately followed by the placing of frames and covers. Indeed, a piece of cheese cloth or muslin should be spread over the plants for shade as fast as they are set and watered. The plants should be set about $1\frac{1}{2}$ inches apart, or closer if the planter wishes a more spindling postura, so that some 2,000 or more may be set in each 3 square yards. Boys should be paid by the piece, and should easily do four or five such beds or more in a ten-hour day. Numbers of the transplanters can be kept well supplied with plants by one boy who scoops them up on spade-like pieces of board, dirt and all, without disturbing them in the least. Plants so handled and properly cared for will gain a week to ten days or more over those left undisturbed from a first planting, and will besides make larger stronger posturas, as we have repeatedly demonstrated here, where any planters might have seen and kept close watch of every operation.

Two-foot paths should be allowed both ways between all the beds, and between every four rows of beds a cart road should be provided for so that manure may be easily carried directly to each bed, and if necessary posturas may be rapidly taken out this same way. We would recommend however, that the seed beds should not be massed in one place but arranged in groups as close as possible to the fields they are intended to serve. They can not be too close. There will be other conveniences in this, connected with water supply and so on, besides the considerable advantages noted below. It will be easy for any planter to estimate the number of these beds 3 by 9 feet or better $2\frac{1}{2}$ by 10 feet necessary for any given

field. Suppose 25,000 plants to the acre be necessary, then it will require 12 to 14 such beds to supply the posturas, according to whether the planter prefers a thin spindling postura or a thick stocky one. One or two extra beds should always be provided to insure against shortages and accidents, which with the class of help available in Cuba are always likely to occur. But with these beds, if properly and intelligently handled, there is no need of preparing more ground than is actually occupied by the plants, whereas commonly in the mountain seed beds a "good stand" of posturas frequently does not occupy but three-fourths, a half, or even one-fourth of the actual area worked, and, on the productive portion, the plants are commonly so crowded that the proportion of well-developed posturas is necessarily small.

SETTING POSTURAS IN THE FIELD.

The immense advantage of having seed beds at the actual side of the vega has been strikingly apparent in every planting out of some hundreds of trial lots here at the Estación. Besides, now that many planters are operating seed beds on their places, abundant evidence comes in from throughout the tobacco region. One planter with whom we are acquainted, last year put out posturas directly from his own seed beds side by side with posturas brought from the mountains. These were all put out at the same time and given the same treatment. His home-grown posturas made a crop ten days ahead of the others. We have obtained still more striking results by combining increased care with which posturas were moved with careful seed and postura selection. Instead of pulling the posturas as is almost universally done, they were removed with the entire root mass and the dirt attached. *This can only be done to advantage in a transplanted bed,* where all the plants are properly spaced. After the posturas have been properly hardened off for a few days and are ready to move, the operator inserts two fingers deep into the soil between the plants, and removes the postura by a lateral and not a vertical motion, and banks the plants, roots, dirt and all into shallow light wooden trays about 18 inches wide by 3 feet long and 3 inches deep, and these covered by a piece of old sacking are delivered by boys to the planters as rapidly as they can be used and not more so. The posturas can be taken out of the beds about as rapidly in this way as in any other. They are set in the same trenches ordinarily used, and watered. Very early the following morning these plants will be found standing erect and crisp, and the same ground should then be gone over by men with hoes and soil drawn around the plants. The posturas from transplanted beds thirty to thirty-five days old will be amply large enough to permit of this. The wetted soil about the plants will then have no time to sun-bake, the plants will not be left at the bottom of a ditch, the victims of any heavy rain, and moreover, *these*

posturas will not loose any time by "durmiendo." Commonly, in Cuban vegas, a week or some times more is practically lost in the "durmiendo"—a wilted condition which lasts until some new roots are put forth. And if a very heavy rain should happen to follow the planting the losses are commonly very great. We have personally known of there being above 50 per cent in loss from plants dying and being flooded. Last season in well-managed vegas in this vicinity, operated under the old system, it required seventy-eight days to make a crop in the open fields and eighty days under cheese cloth, whereas by the modifications we have suggested, and the use of large fine posturas direct from the transplanted beds, as large and as fine tobacco was made in forty-five to fifty days, and this not only in one plot, but in many plots, and with many different varieties, and where all the world might see it.

Again we will grant that it is possible even with very badly abused posturas, to make a good crop if water and fertilizer and labor and time enough are consumed. But is it a good business proposition when by bettering the posturas and the method of handling, and following a system that will insure nearly *continuous growth,* we can get just as good a crop and in some respects better, *with two-thirds the same amount of water, labor fertilizer, and time.* We have proven the possibility of producing a crop—seed to ripe leaves—in from seventy-five to eighty-five days.

Thousands upon thousands of dollars are simply wasted upon every crop of tobacco grown in the great majority of Cuban vegas by the use of poor seed, poor posturas, and improper handling. Each year our demonstrations have shown this most clearly. And yet there is small service to the mass of the planters by redemonstrating this each year at the Estación. It should be demonstrated also at convenient points throughout the tobacco region, where all the world may become acquainted with this same train of facts that have been borne in so strongly upon us here.

CROPS PLANTED AND HARVESTED AND CONDITION OF SAME TAKEN FROM MONTHLY CROP REPORTS FOR THE MONTH OF NOVEMBER, 1908.

[RICE.—Attention is invited to the fact that rice should be understood as being in the unhulled state.]

Province and crop.	Condition.	Planted during month.	Harvested during month.		
			Area.	Quantity.	Unit.
		Hectares.	*Hectares.*		
Agusan (reports from 2 towns):					
Abacá	Good			200	Piculs.
Coconuts	do				
Corn	Fair			150	Cavans.
Albay (reports from 13 towns):					
Rice	Good	2,156	693	11,469	Do.
Abacá	do	687	6,536	20,351	Piculs.
Coconuts	do			628,118	Nuts.
Sugar cane	do	13	23	42	Piculs.
Ambos Camarines (reports from 29 towns):					
Rice	do	2,063	862	8,199	Cavans.
Abacá	do	598	2,397	7,267	Piculs.
Coconuts	do			1,405,600	Nuts.
Sugar cane	do	16	67	100	Piculs.
Antique (reports from 7 towns):					
Rice	do		1,750	23,400	Cavans.
Abacá	do	10	3	15	Piculs.
Coconuts	do			11,000	Nuts.
Sugar cane	do	15	12	335	Piculs.
Bataan (reports from 4 towns):					
Rice	do		392	15,660	Cavans.
Coconuts	do				
Corn	do				
Batangas (reports from 15 towns):					
Rice	Poor	90	7,310	7,516	Do.
Sugar cane	Fair				
Corn	Good	1,007	5	15	Do.
Coconuts	Fair				
Benguet (reports from 11 towns):					
Rice	do		163	820	Do.
Coconuts	do				
Sugar cane	do				
Corn	Poor				
Bohol (reports from 27 towns):					
Rice	Fair	21,272	17,381	25,935	Do.
Abacá	Good	25	138	354	Piculs.
Coconuts	do			3,618,905	Nuts.
Corn	Fair	276	2	30	Cavans.
Bulacan (reports from 11 towns):					
Rice	do	20	666	11,980	Do.
Sugar cane	do	1,330	204		
Tobacco	do	75			
Corn	Poor	195			
Cagayan (reports from 14 towns):					
Rice	Fair	705	163	32,589	Do.
Sugar cane	do	2	7	90	Piculs.
Tobacco	do	199			
Coconuts	Good			4,000	Nuts.
Capiz (reports from 19 towns):					
Rice	Fair	1,080	8,194	315,690	Cavans.
Coconuts	do			265,000	Nuts.
Corn	do	10	66	260	Cavans.
Abacá	do	3,062	784	870	Piculs.
Cavite (reports from 8 towns):					
Tobacco	Good	5			
Corn	do	45			
Rice	do		200	102	Cavans.
Abacá	do		10	120	Piculs.

Crops planted and harvested and condition of same taken from monthly crop reports for the month of November, 1908—Continued.

Province and crop.	Condition.	Planted during month.	Harvested during month.		
			Area.	Quantity.	Unit.
Cebu (reports from 37 towns):		*Hectares.*	*Hectares.*		
Rice	Fair	1,271	1,442	10,233	Cavans.
Tobacco	Good	1,537	59	9,000	Quintales.
Corn	Fair	10,482	1,718	759	Cavans.
Sugar cane	do	691	65	15,947	Piculs.
Ilocos Norte (reports from 10 towns):					
Rice	Good		10,858	178,130	Cavans.
Coconuts	do			4,000	Nuts.
Sugar cane	do	49	226	162	Piculs.
Maguey	do	36		100	Do.
Ilocos Sur (reports from 19 towns):					
Rice	do		10,240	85,209	Cavans.
Corn	do	251			
Sugar cane	Fair	30	304	4,806	Piculs.
Coconuts	do			31,500	Nuts.
Iloilo (reports from 13 towns):					
Rice	Good	9,800	11,347	103,558	Cavans.
Abacá	do	450	103	324	Piculs.
Coconuts	do			21,840	Nuts.
Sugar cane	do	8	16	220	Piculs.
Isabela (reports from 6 towns):					
Rice	Fair	27			
Sugar cane	Poor				
Corn	do				
Tobacco	do				
La Laguna (reports from 17 towns):					
Rice	Fair	749	1,540	17,403	Cavans.
Sugar cane	do	27	16	75	Piculs.
Abacá	Good	3	391	403	Do.
Coconuts	do			4,924,350	Nuts.
La Union (reports from 11 towns):					
Rice	Fair	1,025	15,299	117,522	Cavans.
Coconuts	Good			5,500	Nuts.
Corn	Fair	18			
Sugar cane	do		12	150	Piculs.
Lepanto-Bontoc (reports from 16 towns):					
Rice	Good		287	11,576	Cavans.
Coffee	Fair		156		
Corn	do	6		2,000	Do.
Coconuts	Good				
Leyte (reports from 15 towns):					
Rice	Fair	151	1,916	15,894	Do.
Abacá	Good	174	2,311	11,884	Piculs.
Coconuts	do			272,500	Nuts.
Corn	Fair	450	515	16,897	Cavans.
Mindoro (reports from 1 towns):					
Rice	Poor		50		
Abacá	do	4	80	70	Piculs.
Coconuts	do			12,000	Nuts.
Misamis (reports from 6 towns):					
Rice	Good	200	1,209	38,950	Cavans.
Abacá	do	23	383	5,460	Piculs.
Coconuts	Fair			579,442	Nuts.
Sugar cane	Good	4	3	120	Piculs.
Moro (reports from 5 towns):					
Rice	do		150	3,939	Cavans.
Abacá	do	3	602	617	Piculs.
Coconuts	do			23,000	Nuts.
Corn	do	10	100	300	Cavans.
Nueva Ecija (reports from 18 towns):					
Rice	do		2,541	38,475	Do.
Sugar cane	do	8	82	800	Piculs.
Coconuts	do			8,000	Nuts.
Corn	Fair	37			
Nueva Vizcaya (reports from 4 towns):					
Rice	Good	2,077	365		
Coconuts	do				
Sugar cane	do	51	31		
Corn	do	3	3		
Occidental Negros (reports from 12 towns):					
Rice	Fair	30	6,270	88,040	Cavans.
Sugar cane	Good	630	1,485	21,600	Piculs.
Coconuts	do			65,000	Nuts.
Corn	Fair	2,110	280	5,900	Cavans.

Crops planted and harvested and condition of same taken from monthly crop reports for the month of November, 1908—Continued.

Province and crop.	Condition.	Planted during month.	Harvested during month.		
			Area.	Quantity.	Unit.
		Hectares.	*Hectares.*		
Oriental Negros (reports from 11 towns):					
Rice	Fair	35	380	3,810	Cavans.
Abacá	do	201	178	1,116	Piculs.
Coconuts	do			300,200	Nuts.
Corn	do	3,696	932	9,794	Cavans.
Pampanga (reports from 10 towns):					
Rice	do		594	8,450	Do.
Sugar cane	Good		2	20	Piculs.
Corn	Fair	7			
Pangasinan (reports from 34 towns):					
Rice	Good	4,297	19,579	205,699	Cavans.
Coconuts	do			154,816	Nuts.
Sugar cane	do	112	865	7,000	Piculs.
Corn	do	10,705	42	650	Cavans.
Rizal (reports from 13 towns):					
Rice	Fair		5	150	Do.
Abacá	Good				
Sugar cane	Fair		5	50	Piculs.
Corn	Poor	55	2	10	Cavans.
Samar (reports from 17 towns):					
Rice	Fair	126	323	1,708	Do.
Abacá	do	245	2,280	4,497	Piculs.
Coconuts	do			9,738,900	Nuts.
Corn	do	9	4	127	Cavans.
Sorsogon (reports from 18 towns):					
Rice	Good	777	3,050	1,300	Do.
Abacá	Fair	611	28,751	9,521	Piculs.
Coconuts	do			65,627	Nuts.
Corn	do	173	30	205	Cavans.
Surigao (reports from 2 towns):					
Rice	Excellent	500			
Abacá	Good	160	250	1,105	Piculs.
Coconuts	Excellent			26,986	Nuts.
Corn	do		200	13,698	Cavans.
Tarlac (reports from 11 towns):					
Rice	Good	1,745	5,409	106,968	Do.
Sugar cane	do		50	2,570	Piculs.
Corn	Fair	31			
Tobacco	do	13			
Tayabas (reports from 16 towns):					
Rice	do	2,307	2,893	39,226	Cavans.
Abacá	Good	3,257	310	1,565	Piculs.
Coconuts	do			1,885,130	Nuts.
Sugar cane	do	2	16		
Zambales (reports from 4 towns):					
Rice	do		1,478	22,150	Cavans.
Coconuts	Fair				
Sugar cane	do		11	46	Piculs.
Corn	do			10	Cavans.

RANGE OF PRICES OF PHILIPPINE AGRICULTURAL PRODUCTS.

Highest, lowest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the month of November, 1908.

Province.	Rice, unhulled, per cavan.			Abacá, per picul.			Copra, per picul.		
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Agusan	₱2.00	₱1.00	₱1.50	₱8.00	₱7.00	₱7.50	₱6.50	₱6.50	₱6.50
Albay	3.50	2.00	2.75	9.50	6.50	8.00	6.50	4.75	5.62
Ambos Camarines	4.50	2.00	3.25	12.50	4.00	8.25	6.50	5.00	5.75
Antique	2.00	1.25	1.62	18.00	6.00	12.00	7.50	7.50	7.50
Bataan	2.50	2.00	2.25	4.00	4.00	4.00			
Batangas	5.00	3.00	4.00						
Benguet	4.00	2.50	3.25	16.00	12.00	14.00			
Bohol	3.50	2.50	3.00	18.00	2.00	10.00	8.25	6.00	7.12
Bulacan	3.00	2.00	2.50				5.50	5.50	5.50
Cagayan	4.00	2.00	3.00				5.50	5.50	5.50
Capiz	3.75	1.50	2.62	20.00	8.00	14.00	7.50	5.00	6.25
Cavite	3.00	2.00	2.50	16.00	16.00	16.00			
Cebu	5.00	2.50	3.75	17.50	11.00	14.25	10.00	6.50	8.25
Ilocos Norte	4.50	2.50	3.50						
Ilocos Sur	5.00	2.50	3.75						
Iloilo	5.00	1.50	3.25	20.00	18.00	19.00	7.00	5.00	6.00
Isabela	4.00	4.00	4.00						
La Laguna	3.25	2.50	2.87	16.00	7.50	11.75	7.60	4.90	6.25
La Union	4.00	2.00	3.00				8.00	6.00	7.00
Lepanto-Bontoc	4.00	2.50	3.25				10.00	3.00	6.50
Leyte	3.50	2.50	3.00	15.00	6.00	10.50	7.50	2.25	4.87
Mindoro	2.50	2.50	2.50	10.00	10.00	10.00	4.50	4.50	4.50
Misamis	3.50	2.00	2.75	12.00	7.00	9.50	7.50	6.20	6.85
Moro	2.80	2.00	2.40	15.00	6.50	10.75	7.00	7.00	7.00
Nueva Ecija	4.00	1.15	2.57						
Nueva Vizcaya	3.12	1.50	2.31						
Occidental Negros	3.50	2.00	2.75	24.00	10.00	17.00	7.60	6.00	6.80
Oriental Negros	4.00	2.00	3.00	15.00	9.00	12.00	7.70	6.00	6.85
Pampanga	2.80	1.50	2.15						
Pangasinan	4.50	2.00	3.25				8.00	2.50	5.25
Rizal	2.75	2.40	2.52						
Samar	3.75	2.50	3.12	15.00	10.00	12.50	6.50	5.50	6.00
Sorsogon	3.50	2.00	2.75	16.00	6.50	11.25	7.00	5.00	6.00
Surigao	3.00	2.50	2.75	11.50	11.50	11.50	6.00	4.00	5.00
Tarlac	4.50	1.45	2.97				6.00	6.00	6.00
Tayabas	3.50	2.00	2.75	18.00	5.00	11.50	5.75	3.50	4.62
Zambales	2.50	1.00	1.75				4.00	4.00	4.00

Highest, lowest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the month of November, 1908—Continued.

Province.	Sugar, per picul.			Tobacco, per quintal.			Corn, per cavan.		
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Agusan	-------	-------	-------	-------	-------	-------	₱2.00	₱2.00	₱2.00
Albay	₱8.00	₱6.00	₱7.00	-------	-------	-------	5.00	1.50	3.25
Ambos Camarines	4.00	4.00	4.00	-------	-------	-------	4.00	4.00	4.00
Antique	2.75	2.75	2.75	₱6.00	₱6.00	₱6.00	1.50	1.50	1.50
Bataan	3.25	3.25	3.25	-------	-------	-------	1.50	1.50	1.50
Batangas	5.00	4.00	4.50	-------	-------	-------	4.00	4.00	4.00
Benguet	4.00	3.00	3.50	-------	-------	-------	4.00	2.00	3.00
Bohol	4.00	3.60	3.80	20.00	3.50	11.75	3.75	1.50	2.62
Bulacan	-------	-------	-------	12.50	12.50	12.50	2.50	2.05	2.27
Cagayan	6.00	2.00	4.00	15.00	6.00	10.50	3.50	1.75	2.62
Capiz	5.00	5.00	5.00	15.00	5.50	10.25	2.50	1.50	2.00
Cavite	3.75	2.50	3.12	-------	-------	-------	2.25	2.25	2.25
Cebu	8.00	2.00	5.00	29.00	4.50	16.75	6.00	2.00	4.00
Ilocos Norte	4.00	2.50	3.25	19.00	4.00	11.50	3.50	2.50	3.00
Ilocos Sur	7.00	2.40	4.70	60.00	7.00	33.50	5.00	3.00	4.00
Iloilo	6.00	4.00	5.00	30.00	5.00	17.50	3.12	2.00	2.56
Isabela	-------	-------	-------	15.00	15.00	15.00	3.00	3.00	3.00
La Laguna	5.00	3.80	4.40	-------	-------	-------	3.10	2.50	2.80
La Union	7.50	2.50	5.00	8.00	8.00	8.00	3.00	3.00	3.00
Lepanto-Bontoc	3.50	2.50	3.00	13.00	4.00	8.50	6.00	1.00	3.50
Leyte	6.00	3.00	4.50	25.00	3.50	14.25	3.50	2.50	3.00
Mindoro	-------	-------	-------	-------	-------	-------	-------	-------	-------
Misamis	-------	-------	-------	-------	-------	-------	-------	-------	-------
Moro	5.00	5.00	5.00	-------	-------	-------	2.50	2.50	2.50
Nueva Ecija	7.50	5.00	6.25	20.00	6.25	13.12	2.00	1.25	1.62
Nueva Vizcaya	-------	-------	-------	20.00	5.00	12.50	2.00	1.50	1.75
Occidental Negros	4.75	3.00	3.87	35.00	30.00	32.50	2.50	2.00	2.25
Oriental Negros	5.00	5.00	5.00	25.00	25.00	25.00	4.00	2.50	3.25
Pampanga	4.50	3.50	4.00	-------	-------	-------	2.50	2.50	2.50
Pangasinan	7.00	2.00	4.50	55.00	6.00	30.50	5.00	1.50	3.25
Rizal	5.00	3.00	4.00	-------	-------	-------	3.75	2.50	3.12
Samar	4.50	4.50	4.50	-------	-------	-------	4.50	2.50	3.50
Sorsogon	6.00	2.00	4.00	12.50	10.00	11.25	4.00	1.50	2.75
Surigao	4.00	4.00	4.00	17.00	2.00	9.50	2.50	1.25	1.87
Tarlac	6.00	1.85	3.92	6.50	6.50	6.50	2.00	2.00	2.00
Tayabas	6.25	4.00	5.12	8.00	7.00	7.50	-------	-------	-------
Zambales	6.25	5.00	5.62	-------	-------	-------	-------	-------	-------

PUBLICATIONS OF THE BUREAU OF AGRICULTURE.

The following-named bulletins of the Bureau of Agriculture are available for distribution, and will be sent free of charge to any address upon application. Applicants are requested to state whether all publications of the Bureau are desired as issued, or only those specified. The name and address of the applicant should be plainly written and all communications should be addressed to the Director, Bureau of Agriculture, Manila, Philippine Islands.

FARMERS' BULLETINS.

No. 4. Preliminary Report on Commercial Fibers of the Philippines. (Spanish.)
No. 6. Experimental Work with Fungous Diseases of Grasshoppers. (Spanish.)
No. 9. A Few Suggestions on the Cultivation of Cotton. (Spanish.)
No. 11. The Jute Industry. (English and Spanish.)
No. 12. Abacá. (Manila Hemp.) (English.)
No. 13. The Cultivation of Maguey in the Philippine Islands. (English and Spanish.)
No. 14. The Cultivation of Sesamum in the Philippine Islands. (Spanish.)
No. 15. Tobacco Growing in the Philippines. (English and Spanish.)

PRESS BULLETINS.

No. 6. The Tamarind. (English.)
No. 8. Maguey; Propagating Abacá from Seed; etc. (English.)
No. 9. Agricultural Districts; Control of Rinderpest; etc. (English.)
No. 11. Seed Distribution; Need of Diversified Farming; etc. (English and Spanish.)

POPULAR BULLETINS.

No. 1. Maguey. (English, Spanish, Tagalog, Visayan, Ilocano.)
No. 2. Kapok. (English, Spanish, Tagalog, Visayan, Ilocano.)
No. 3. Directions for Planting Farm and Garden Seeds. (Spanish.)

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